I, Devakhi a/p Pandari Nathan (Matrics Number: WET000079), proclaim that the thesis, is original and any references used are listed within the written documentation as footnotes.

Devakhi

ABSTRACT

E-Learning : Encyclopedia of the Human Body is a web-based online learning system that is developed for medical students. The proposed system is meant to give medical students a more conducive and interactive form of learning apart from the conventional text book learning. This system is also meant to help educators to relay certain knowledge to these medical students. Besides that, the system also includes a level by level multiple choice test, as an option for the medical students that uses the system to evaluate their progress in understanding the material in the system and in their syllabus in general. The system is designed to keep track of the user's (user must have a user ID and a password to log on to the system) score in the tests, and to deny access to a higher-level test if the said user does not pass the lower level test. There is also a built in search engine in the system to help the medical students look for specific information in the system's encyclopedia.

The 'E-Learning : Encyclopedia of the Human Body' system is divided into two main sections which are the user and the administrator sections. The user section is the main interfaces, which includes the encyclopedia, the level-by-level tests, the search engine and the other web pages that are provided to the user, which in this case is mainly the medical student. The administrator section is called the 'Administrative Console' and is used by the administrator of the system to manipulate the information within the system,

which includes editing, deleting, and adding test questions, information and accessing the user information. This is to make sure that the information within the system is inline with the latest progress in medicine or the latest inclusion of material into a medical student's syllabus scope.

The waterfall approach is selected for the development process because it is easy to follow and provides a well-organized method of developing the system. Besides that, this methodology is suitable for the development of the system (system analysis, design, coding, and testing), because the system has very clear-cut steps which do not require prototyping or reassessment; the availability of the Administrative Console' makes any changes possible even when the system has been produced and released. Generally the system is developed using Active Server Pages technologies on a Microsoft Windows 2000 Professional or Microsoft Windows 95/98/ME platform.

There inherently was some complications in the establishment of the 'E-Learning : Encyclopedia of the Human Body' system, due to the lack of exposure to the type of tools and programming languages needed to build the system, but all in all, this is a very practical system to build as its benefits are very apparent. Besides that, this system will provide a foundation for future innovation in the field of e-learning.

ACKNOWLEDGEMENT

I would like to take this opportunity to extend my appreciations to everyone that has contributed to the success of this thesis. I do apologies to anyone I may have failed to mention; your help is greatly appreciated by me.

First and foremost, I would like to extend a heartfelt thank you to my supervisor Pn. Rafidah, for her invaluable guidance and advice that was promptly given to me.

A special thanks goes out to Dr. SP Palaniappan for his time and patience in providing me the medical information needed for the encyclopedia and in guiding me to forming multiple choice questions that are considered relevant to the system at hand.

As for my family members, I cannot express enough the gratitude I feel for your enduring support and love, without which I do not think this thesis would have been possible.

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ABBREVIATIONS

Below is the list of abbreviations used in the thesis report:

ASP	- *Active Server Pages*
HTML	*-Hyper Text Markup Language*
IIS	*-Internet Information Services*
IDM	*-Intelligent Software Agent Based Data Mining*
JSP	*-Javascript Server Pages*
NTFS	*-NT File System*
SQL	*-Structured Query Language*
TCP/IP	*-Transport Control Protocol/Internet Protocol*
WWW	*-World Wide Web*
PBS	*-Public Broadcasting System*
LAN	*-Local Area Network*
ME	*-Medical Encyclopedia*

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CHAPTER I

INTRODUCTION

1.1 Project Introduction

In the wake of a global science and technological growth explosion, more and more achievements are being made that were once considered unattainable. Though it is a reality in part that the West has dominated such advancements, our own country is taking the necessarily steps to keep in tuned with this progression. With the emergence of the Multimedia Super Corridor (MSC), the world of Information Technology has taken its foothold on local soil and has attracted investors from all over the world. Considering the interest the government and NGOs alike in the field of information technology, there is a driving need to keep abreast in such advancements in order to develop ourselves.

One of the main developments in the field of Information Technology would be the Internet. Through the Internet, lots of transactions and communication has been made available with a network of users all over the world. Such uses are namely, learning, businesses, and many others that are passed through to the Internet user in an

online mechanism through the Internet. Going 'online' has become a big part of the growth and expansion of the Internet and the extensive use of it, however there are still some areas that has not touched this method of relaying information as it is still new in certain sections of education for example. Because of the more traditional mindset of teaching and education, parts of society have proved to be skeptical in using the Internet as a medium to relay such information. This apparent mindset would have to be changed to keep up with a more cutting edge technologies that will bring about a bounty of benefits and good returns.

The field suggested in this thesis that needs improvement to be in tuned with the above mentions online development is in the field of medicine. Though it has was been acknowledge that the use of modern technology has brought about great achievements in the medical field, hence the term modern medicine, it is ironic that technology has been lacking as far as the education of medicine in concerned. In the scenario today, medical students are almost solely reliant on textbooks, which are by nature non-interactive to deal with a very human, and interactive problem, which is human sicknesses.

Due to this, a change is needed where a system of medical E-learning be created. In this system, education will be relayed in a more 'human' encyclopedia manner, with a multiple answer questionnaires to tests the students understanding after every phase of the encyclopedia. That way, the student will know immediately of his or her knowledge of a subject in the encyclopedia before continuing into more difficult subject matters. This system will be posted on the Internet because of its easy accessibility in reaching out to students. The prototype subject matter would be an encyclopedia of the human body especially in the area of the ear organ, as the knowledge of the human body is one of the basic subjects that a medical student must master.

1.2 Analysis Of The Problem In Hand And The Identification Of The Target Users

An analysis of the problem in status quote must be done in order to establish a need for the change and also to identify the target users needs that brings about the calling for such a change. Since this thesis is to bring about an online E-learning system for medical students, the first step is to identify the limitations of the old manual system, and how this new online system will help remedy those limitations. Since these limitations, which will be elaborated in a bit, exist in the realm of the field of medicine, the target users will than be, medical students per se.

One of the problems identified is that the use of online learning in this field has not been fully explored to discover its full potential. There are a few existing websites that do display or provide medical information or tutorials much like the textbooks, which is pretty static in the sense that it does not come hand in hand with a mechanism to test the user of the site regarding their knowledge of information provided by the website. Therefore these websites, proves to work more as an archive of information rather than a method of effective teaching of the displayed medical knowledge. This becomes a problem, as a medical student would than be left without an effective means of falling back on subjects relayed during the lecture sessions at faculty.

Therefore with this new online system, medical students would have a system that would refresh their memories on areas of medicine, and in this case the human body, and test them regarding these items, as a means of improving a students understanding of the knowledge that has been fed to them. Because of its easy availably via the Internet, medical student will be able to tap into these refreshment notes and exam easily and at any given time, without the hassle of looking through and carrying about heavy medical textbooks.

Below is the list of other limitations in the current system that calls for a change. A new system cannot be build effectively without first identifying and examining these limitations:

(a) Textbooks and reference books can be expensive and heavy

Because of the ever changing and ever increasing knowledge in the field of medicine, a medical student will be than forced to purchase new materials to read up on to keep abreast on such changes. The advancements in medical diagnosis and treatment also take away the option of medical student recycling the use of their senior's textbooks, as some information might already be obsolete during their term of study. Therefore, it becomes extremely expensive for a medical student to keep purchasing newly updated medical references that can range to the hundreds of Ringgit, only to find it lacking some newly discovered knowledge, after a period of time. Besides the fact that these written material will inevitably become out-of-date, most of these books are thick and heavy, making its rather cumbersome to carried about. Thus, these references are not always available when its need arises, as a medical student can't possible lug it around all the time.

(b) The lack of use of teaching tools

Most lecturers in the university today depend on the use of a whiteboard or blackboard to run their classes. These will than mean that a medical student will have to divert their attention to taking down notes while listening to the lecture that is being relayed verbally. Though this traditional method of teaching has long been used, we find that this does not only compromise a student's attention but also means that a student will tend to miss out on some vital information if the said student couldn't manage to write down what was written on the board before it has been erased. Besides that, where the technique of using slides, transparencies and projectors in aid of teaching are concerned, a lot of time is taken up in preparing these slides and transparencies, thus becoming a burden to the lecturer. Besides that, this method still does not take away the problem of students having to compromise their attention to an extent to try and copy down the notes displayed on the projector screen. Because such teaching tools are not computerized, the option of animating graphics to explain a certain bodily process

for example, becomes a void option, therefore leaving the lecturer with the burden of trying to explain such processes without any stimulating visual aid.

(c) The unavailability of help outside of lectures

Most lecturers in the medical faculty in the local universities are also full time doctors in the university hospital, or private practitioners in some occasions. Therefore their time with the students are usually limited to within the lecture periods. This lack of free time also means that they naturally would have less time to prepare more comprehensive slides on their lectures as most of it is verbally relayed to save them preparation time. This then means that the students would be lacking proper references if they were to obtain the slides and also that they could have little help from their lecturers outside the lecture period.

(d) No tangible system to constantly test the student's understanding

Most of the medical textbooks come with after chapter tutorials to test the students understanding, but where this is lacking is when it comes to grading the student's comprehension of the past topic. Without these grading system provided by the textbooks, the student could advance to other more difficult chapters without fully understanding the previous chapter. The only time that a student is truly graded and tested for their understanding is during exams and class tests, but those happens only twice or in some occasions three times a semester which can prove to be ineffective and not sufficient.

(e) Insufficient numbers of available online medical encyclopedias

There are very few medical encyclopedia available online for the use of medical students. Most of those that are available are usually very information comprehensive to the extent that they lack the use of animation or other more interactive medium that can proof to be helpful in the learning process. There are a few however that do provide commendable graphics, audio and video but than lacks the understanding check in the form of tutorials and tests. Even if a website were to be found to have fulfilled all the above criteria, it will than not have the

important structure that emphasizes or focuses on education or teaching a medical student the sciences of medicine. This is apparent in the available online human body encyclopedias today, where the information are usually very general and not suited or sufficient for a student that will one day me a medical doctor.

(f) Lack of available practice questionnaires

Even though there are available questions after each chapter in a medical textbook, it isn't wholly structured to test a student on his or her understanding of the past chapter as most of the questions aren't always in the form that an exam question might be like and the answers are available for the student's perusal; this would tempt a student to memorize the explanation behind each answer rather than really making an effort to understand why the answer is such. Also because in most cases in the education of medicine, the invigilator takes the exam questions back after an exam, the students are left without a reference of past exam questions to test themselves on.

Based on the above problems or limitations posed by the available system of medical education, it is than justified that a new method or system should be developed to remedy these limitations.

1.3 Project Objectives

The main objectives of developing the *E-Learning: Encyclopedia of the human body* is as listed below:

1. To make available an online system that can be accessed by a medical student wherever a computer with an Internet connection is available, at any time of the day for their references.

2. To provide a mechanism for a student to be tested and graded in the end of each chapter or topic, to help the student keep track of his or her progress or level of understanding.
3. To provide a more comprehensive and medical syllabus orientated topics with avenues to develop multimedia functions to form a more dynamic and conducive way of relaying important information to the medical student.
4. To provide a search mechanism in the system to help the student look for specific information from the available topics in the system archive. This search mechanism will display the list of information looked for by the user, using a SQL statement that runs a *query* based on the sentence or word typed in by the user for the search.
5. To develop and Administration Console, to make it easier for the website administrator to manipulate the information in the system's database without having to access the database via the server. The kind of manipulation meant in this context, is to edit, add, or even erase information in the encyclopedia, test, or even from the user's personal information.

1.4 Project Scope

1. The development of the system is more of a prototype, so for the time being it will lay emphasis on the human ear.
2. The application being developed is mainly for the use of medical students but it can also be used as a teaching tool for lecturers if the need arises.
3. The application will be split into smaller sections, where the student must pass the first level test before advancing to the more difficult test levels.

4. The grading of a student's understanding will depend on his score of each level of this multiple choice test questions that is split into three different levels, with varying difficulty.
5. The application will be dynamic, as the system's administrator will be able to keep the system updated with new information and questions from time to time, using the administrative console. That way the application won't be static and will be up to date.

1.5 Project Limitations

Because this is the initial stage of the development of the new system, it is difficult to foresee the kind of limitations that it might incur once it is up and running. However, one of the main limitations that the system will have is that its test questions will be limited to multiple-choice questions. Though, essay and structure questions can be implemented in the system, it would not seem practical, as an expert in the field would than have to check and grade these answers, which would take time and a lot of effort, and possibly a lot of money.

Another possible limitation is that with the addition of too many multimedia elements in the system, its loading time might increase to an extent that will discourage the student's use of the system. Because most of the computers provided in the local universities have very basic functions, it does not posses high processing speed that will speed the process of loading the system. Therefore, the prototype application might compromise the use of many multimedia elements.

1.6 Importance Of The New System

This E-learning project is an important development because it will serve to help medical students to access vital information where ever they may be as long as an Internet connection is available. Besides that it will provide a practice for students to apply what they have learnt in order to grade the level of their understanding. Also, this will be an information source that will be constantly upgraded to keep up with new discoveries in the field of medicine, and will also have levels of test questions that will randomly change to make sure that a student will always be tested on new sets of questions.

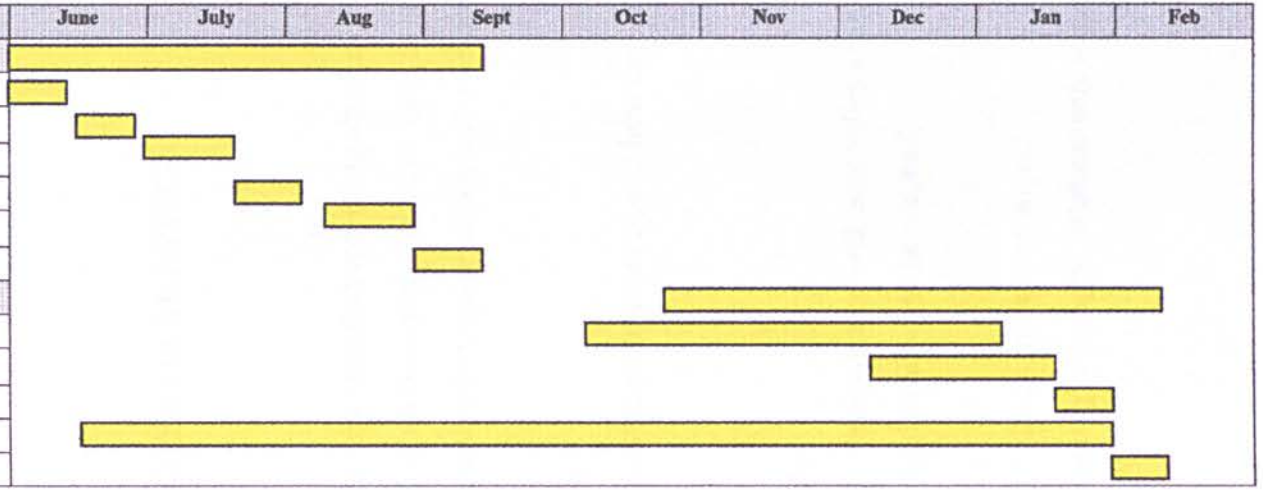
With this system also, lecturers will now have an option to teach their student's with more comprehensive notes and better graphics. With this system, animation can also be included, so as to further improve the quality of the lecturer's lesson, as they will now be able to explain processes and methods with a good visual presentation for the student's understanding.

Besides that, the development of this project would also prove important in the development of a new and improve useful application in the field of E-learning. Now, other developers can use this idea to develop systems of the same nature but in different fields of education.

With all of these benefits at hand with the development of this project, it is clearly vital to form such an application.

1.7 Gantt Chart

ID	Task Name	Duration
1	**Semester 1**	**15 weeks**
2	Feasibility study and proposal report	2 weeks
3	Introduction (Chapter 1)	2 weeks
4	Literature review	3 weeks
5	System Analysis	2 weeks
6	System Design	3 weeks
7	Viva	2 weeks
8	**Semester 2**	**16 weeks**
9	System Coding	15 weeks
10	System Testing	6 weeks
11	System Implementation	2 weeks
12	System Documentation	34 weeks
14	Viva	2 weeks



CHAPTER II

LITERATURE REVIEW

This chapter will research into facts that will bring about a better understanding as to why such a project is needed in status quote, and other facts in regards with what the project is about. This chapter is split into 6 major topics such as stated below:

- Introduction to the Internet
  Includes explanation as to what an Internet is, and how the Internet is related to the proposed project.

- Introduction to E-Learning
  Explains what is learning electronically, and establishes whether it is a good method to fulfill objectives that needs to be reached.

- Tools that can be used to build the proposed project.
  Looks into the kind of scripting languages, database soft wares, and servers available in the market.

- Server/User structure

  Look into the structure in which the use of the proposed project, is based on.

- Multimedia elements

  What type of multimedia elements are involved and the factors that needs consideration in choosing the types of element to be incorporated in the project, for example in terms of audio and video.

- Case analysis

  Research into the different types of available products found on the web and the weakness of these alternatives in comparison with the proposed project.

2.1 Introduction To The Internet

In the 1960s, The Ministry of Defense in the United States of America started showing keen interest in the use of networks of computers to give it an edge in the country's defense purposes such as during war. This then led to the establishment of a research team of experts in the field known as the *Advanced Research Projects Agency* (ARPA)1. ARPA identified that even though there were many functioning networks of computers, there was no real way to link each of these separate networks. Therefore, ARPA started researching into a technology that can link several networks so as to form interlinks with every computing apparatus in a big organization. ARPA started with some basic ideas, and started offering research grants to researchers in the field, and also to academicians, and supervised a collaboration and co-operation of efforts amongst the researchers, as a means to solve the problem at hand. The researchers would then discuss their findings, to formulate new ideas from each of these discoveries.

Instead of allowing the researchers to discuss their ideas in theory, ARPA encouraged these researchers to implement their ideas on the computer. ARPA selected only those who were interested and keen in experimental work and pushed them to build a prototype software to test their ideas in a more practical form.

From these efforts, the birth of the Internet came into being, where the Internet is a short form of the term Internetwork. There are two major elements of the Internet software that was revolutionary and important, which are the Internet Protocol (IP) and the Transmission Control Protocol (TCP)2. The Internet Protocol allowed for the basic communication that happens on the Internet, while the Transmission Control Protocol is to supplement any other needs in the application of the Internet. This brought about the name TCP/IP that is a common term in relations to the Internet, although its formal term for this specific software is The TCP/IP Internet Protocol Suite.

The product of this discovery is an open system that allows for the sharing of information and easy accessibility. The basic technique in ensuring a fair distribution of resources in between the terminals of this shared network is called packet switching. Before a data can be sent through the network, it must first be broken into segments known as packets. Each packet has a header noting the destination computer address; the destination address is a code number that is specific to one individual computer. The computers that share this network would then take turns in sending out packets through the network. Each computer sends out one packet for each turn it takes.

Although, hardware such as printers can be linked to the shared network, the hardware must first possess a microprocessor to communicate through the network.

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1 http://www.isoc.org/internet/history/brief.shtml#Introduction

2 http://www.isoc.org/internet/history/cerf.html

Electronically based education through the Internet provides an exercise facility, which can be repeated over and over depending on the needs of the student. For example, a student can retake an online test as many times as he or she wishes to better their understanding and as a form of exercise for what they have learnt through tutorials and its like. It also offers a learning environment that is both fun and conducive, while relaying the information that is needed by the student, whenever and wherever the user may be; provided that an Internet access is available. Prior to the use of such technology in the education field, a professional who would like to learn up or exercise what they have learnt would either have to take part in a course or tutorial by a trainer or lecturer (ILT), sometimes for the span of a few days, or train up using the computer (CBT) through the use of a CD ROM or Web.

The ILT was beneficial as it made it possible for a student to interact in a face-to-face manner with the lecturer or trainer. In the corporate world, the ILT also meant that the professional would be absent in the office to attend such training, which is beneficial in the sense that the professional would be able to give full concentration in training up a particular skill. However, the ILT is expensive – a five-day training session can reach up to more than RM2000 to RM4000, which also meant that the company would be short of a worker for the span of time the training is being conducted. On the other hand, the CBT offers a flexible choice of time and location for the student, – lessen the impact on the employer – allowing them to schedule their own lesson time, and work on their own pace. Nonetheless, this form of education meant that there would be no interaction with the trainer, which meant the lack of the dynamic presentation of knowledge, which made this option less attractive.

2.2.1 E-Learning Style And Statistic s

Come year 2003, it is estimated that only 50% of IT training will be run in the traditional method using a trainer. In the analysis carried out by the Clinton

Administration, it is stated that the Country's Information Infrastructure, with the use of commands based on computers, is cost effective and allows for 30% more learning, where there will be 40% less time taken, and 30% less in overall costs. Training based on technology will also increase four folds in the coming five years 4.

There has been more information produced in the past 30 years in comparison with the 5000 years preceding that 5. The Internet has also seen expansion and progress at a rate of 1000% from the year 1990 to 1999 6.

Based on the research done by Framingham Massachusetts-based Information Data Corporation (IDC), the market of online learning is generating US$600 million in yearly resit and will reach over US$10 billion come 2002. In the latest study done by an American corporate body, which was run by the Masie Centre, Saratoga Springs New York-based think tank, 92% of the giant organizations will implement one type of online learning in 2002 7.

Almost half of academic institutions in America now offer online learning as a part of their curriculum and 85% of these institutions will adopt online learning by the year 2002. The industry analysis and researcher, Brandon Hall has also observed a return on investment (ROI) for online learning as encompassing a spectrum of the companies and industry. He stated that companies and the industry has saved costs up to 40-60% if a comparison was drawn between training using a trainer, to training presentations using technology.

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3 http://www.kmi.open.ac.uk/knowledgeweb

4 IDC 1999, US IT Education and Training Revenues By Delivery Segment, 1997-2003

5 Price Princhett

6 Alta Vista & Cinnet.com

7 FORTUNE On-Line Learning Supplement (May 24, 1999, Vol. 139, no. 10)

Statistics from the research done by the American Public Broadcasting Service [8] (PBS) regarding:

Computer Learning in the Classroom:

Students who attends lectures in higher education institutions	13 million
Students that register for tertiary level courses online	1 million
Higher education institutions that provide courses regarding the Internet	25%
Expanses accumulated for long distance learning in the US for the year 1997	1 billion
The progress of the market since 1992	300%
Students who has completed high school education, owning one or more computer	5.3 million
Students that receives class assignments in an electronic form	40%
Institutions that faced lack of support from students in the integration of technology in the institution's curriculum	2%

People Who Opt to Resume Their Studies:

Students who are aged 25 years and above	43%
Students in the year 1978 that were 25 years of age or more	28%
Jobs that require education or training above the high school level, as stated by the Labour Ministry of America	85%
Jobs in the year 1950 that required education or training above the high school level	40%
Jobs that provides training	58%
Companies that provides learning technology which includes the Internet	48%

Motivation in Providing E-Learning:

Institutions that recognizes the increase in student's achievement as directly linked with the absence of time constraints	63%

Those who states that a cheaper education is important for students 49%

Those who states that lessening the financial cost of institutions is important 20%

2.2.2 Internet And Education [9]

The Internet can work as a catalyst and systematic agent of change. A systematic agent of change, as implied by its name, is the renewal of the style of teaching and learning and also creates a change in the very structure of how the educational institution itself interacts with society.

An educator that acts as an agent of change would create a learning environment where there is active participation of the students in integrated projects, which studies the scenarios of the real world. In comparison with following a lecture in a passive sense, students can now direct their learning ability by showing interest in following and taking responsibility in managing their projects. Instead of memorizing their facts and figures, which usual leaves a student confused about how to apply this knowledge that they have attained, the students will now be equipped with a high level of thinking skills that allows them to be able to use these knowledge in solving real problems effectively. Students are also encouraged to work with other people, thus giving them an avenue to expand out of the isolation of a student that merely focuses on receiving information. The Internet, being a source of information and a communication tool, can now provide this form of better learning to students, as it opens up avenues for students to looks for up to date information while interacting with the expert and friends from all over the world.

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8 http://www.PBS.org/netlearning /stats.html

9 http://www.kmi.open.ac.uk/knowledgeweb

The educator themselves will also end their isolation, as the Internet provides them a way to look for friends online that can help them improve their teaching skills or answer important queries, and also the Internet equips these teachers with a limitless source of information so as to give them an edge in their lectures in the classrooms. The uniqueness of the Internet is mainly this: no matter how specialized the field of interest one might have, there will always be someone using the Internet that can show the way, or act as a guide in providing the user with the skill or knowledge needed; the Internet serves as a platform where people can play the part of assisting others in receiving needed information. Therefore, this makes the Internet a useful entity in providing a means for people to share skills and information, while forming potential cooperation that can bring about more professional development.

2.2.3 How the Internet Supports Education [10]

The Internet works as a support for projects and education by taking away barriers of information access. With the Internet and also a good teacher, a student will inherently learn the skills of identifying relevant information and with the communication between themselves and other people through the Internet, they will gain experiences that will equip them to face the real world.

One of the major strengths of the Internet is accuracy and timeliness in providing needed information. This sets the Internet apart from other sources of information such as the media, because the Internet has the ability to provide more up to date information. In earlier times, the exchange of information across the globe may take

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10 The Knowledge Web: Learning and Collaborating on the Net; *Eisenstadt,Mark* and *Vincent, Tom*; Kogan Page

up to a few months to be accomplished, but now this information exchange can happen in the matter of minutes or seconds for that matter. Any curriculum that depends on recent incidences, such as the implementation of new government policies, the development in the environment or scientific discoveries, will be able to find these up to the minute information through the richness of the source of information provided by the Internet.

Any forms of curriculum that opens the door to the outside world to the students, will be enriched with the ideas, experiences and facts offered by the Internet. The student will now have a wider audience and choice that will help them increase the quality of their products, such as assignment reports and so on. The real difference is because of the support that the Internet provides, the student will have a whole variety of information, and multimedia facilities such as high quality graphics, to use in their reports and also to encourage the student to take the initiative to learn up new materials by themselves.

2.2.4 Evaluating a Student's Progress 11

The first thing that would pop into an average persons head when you talk about a student's evaluation would probably be tests, quizzes, written exams and so on. The aspect that success is from the ability to score well in these methods of evaluation has been proven wrong by researchers that research the way students learn. The Princeton Review, is one such study that proved that the success in achieving a high grade in a written exam does not equal to success in the student's future careers; Princeton is one of the most renowned higher education institution in America that has received high profits by helping the students obtain better exam grades.

Instead, what the educational researchers has established, is that an evaluation of a student's knowledge must be on going, and be done while the process of

relaying knowledge continuous to the student, to truly reach a success in the sense of an educational target. An evaluation should not come as a test at the end of a chapter but should instead be a method of determining the level of understanding in oneself, throughout the chapter, as a way of building a better foundation in what the student has learnt.

According to Drew Gitomer, a senior scientist at the Educational Testing Service institution, teaching is considered as good if its characteristics incorporate effective evaluation of a student's work, coupled with the feedback of the educator. The agenda behind restructuring the educational system came with a change in the way of evaluating a student's understanding a level-by-level approach. Each level must take into account the student's need to obtain the skills in rationalizing a problem, thinking, researching and the ability to reach an accurate decision in solving a problem.

A student must be aware of the reason for which they are thought a certain subject, and what they are striving for. They must also be able to estimate a stage in which that can be said as a satisfactory success, and must have a means of demonstrating their knowledge. When all the targets has been discussed sufficiently, and procedures drawn out to support these targets, a student then will be able to see what they have learnt and what they understand, and then will be able to pass on these new knowledge to other students through interaction.

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11 NetLearning: Why Teachers use the Internet; *Serim, Fredi* and *Kroch, Melissa*; O'Reilly and Assc

2.3 Tools

The proposed project is broken up into three major parts that can define the type of tools needed to create a functioning program. The first part is a user interface that would require the use of authoring tools, which generates simple Hypertext Mark Up Language (HTML). The second part is the scripting language or the Application Program Interface (API) needed to generate a link between the interface to the database to store and retrieve information. Lastly, is the database itself, which is crucial in program dynamic as data can be store and accessed when, needed by the user.

2.3.1 Scripting programming languages/ Application Program Interface

There is certain scripting programming languages that can be inserted into HTML codes of a user interface to access databases. Besides that, a link between the interface and the databases can also be done using an Application Program Interface (API). This is important in the proposed project as accessing the databases is important in storing user information, storing tutorial notes, and also in storing the test questions and answers. Below is a few scripting languages that can be used to accomplish this task:

a) Java Database Connectivity (JDBC) [12]

This is an Application Program Interface (API) specification to connect Java written program to data in popular databases. The access request statement in this case is encoded in Structured Query Language (SQL), that is then linked to the program managing the database. A similar interface is used to return the results. The JDBC bares some resemblance to SQL Access Group's Open Database

12 http://searchdatabase.techtarget.com/sDefinition/0,,sid13_gci214050,00.html

Connectivity (ODBC). Also, using a small "bridge" program will enable the JDBC interface to access databases through the ODBC interface. For example, you could write a program designed to access many popular database products on a number of operating system platforms. When accessing a database on a PC running Microsoft's Windows 2000 and, for example, a Microsoft Access database, your program with JDBC statements would be able to access the Microsoft Access database.

b) Structured Query Language (SQL) [13]

SQL is an ANSI (American National Standards Institute) standard for accessing database systems. SQL statements are used to retrieve and update data in a database. SQL works with database programs like Access, DB2, Informix, Microsoft SQL Server, Oracle, Sybase, and many others (but unfortunately most of them also have their own proprietary extensions to the language). SQL is an important part of ASP, because the Active Data Object (ADO) used in ASP to access databases, rely on SQL for data access.

c) Microsoft Active Server Pages (ASP)

ASP is a technique for programming web pages on a platform that allows for the development of dynamic websites and other interactive application online [14]. With the use of ASP, HTML can be combined with other scripting languages such as VBScript and JavaScript and other COM objects to form an interactive web page, which has accesses to databases. ASP uses a technique known as Server Side Scripting which means that when a browser runs a web page with the .asp format, the server will first process the .asp file from the start to the end, running any VBScript or JavaScript programming before sending the result to the user via the browser. Also, due to the fact that the script programming is run on the web server and not the user's server, all forms of processing will take place in the

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13 http://www.w3schools.com/sql/sql_intro.asp

14 Active Server Pages Bible; *Smith, Eric*; IDG Books Worldwide

server and not with the client. This form of Server Side Scripting [15] has an advantage as a means blocking the user from finding out the type of programming done to enable the functions that are seen on the web page.

2.3.2 Databases

The database is an essential part of the proposed project, because the site is based on an extensive amount of data and information. Below, is a few databases available in the market that can be used for the project:

a) DB2 Universal Database [16]

This product, mainly that of version 7.0, provides a host of factors that makes it compatible for most E-Commerces, CRM, ERP, and Business Intelligence applications, which includes, a high performance, scalability, reliability and availability. This product is easy to deploy, use and manage and provides the lowest cost of ownership. Besides that, it is also able to access and integrate multiple data types from multiple geographically separated sources on different platforms. What's more is that it runs on both IBM and non-IBM hardware supporting multiple operating systems. And was the first database product certified for Microsoft® Windows® 2000 Server. One of the uniqueness of this product is that it has the first RDBMS with integrated in-memory text search capabilities delivered with the new DB2 Net Search Extender; this makes searching for data within the databases so much easier with its built in function.

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15 Active Server: A Developers Guide; *Brook, Wayne*; M&T Publishing Inc.

16 http://databases.about.com/gi/dynamic/offsite.htm

b) Oracle [17]

One of the main edge possessed by this database in comparison with the other similar products in the industry, is its stability as a database. The database will still be functional even if the server crashes or the site fails. Besides that, it is highly stable and able to support a large quantity of data in comparison with the other databases in the market. This database is also extremely secure with 15 security evaluations (DB2 has none). With this database, business data can also be united with Extensible Mark Up Language (XML) content, all in a single database. With the reasonable price of buying this product, the user will also be able to have the database functioning in different platforms such as Windows, and Linux.

c) Microsoft Access [18]

This database delivers a powerful tool for managing and analyzing data. Developers can create sophisticated enterprise-wide database solutions that integrate easily with the Web; the product supports XML that can prove to be useful in accomplishing this task. One of the main appeals of this database is its usability in relations to new users; it has a wide array of tools that can help the user to accomplish functions needed in the database easily. Though this database can be rather unstable under a bulk of data, it still is a popularly used product as it is easy to use, and is designed in a user-friendly manner, and is productive and effective in its own right.

17 http://www.oracle.com/ip/deploy/database/oracle9i/index.html
18 http://www.microsoft.com/office/access/evaluation/guide.asp

2.3.3 Server

Dynamic web sites are important on the Internet as it would give a competitive edge and fulfill the needs of the Internet users. To provide this ability to the web sites, an approach known as Server-side Scripting is used. Using this approach, programs running on the Web server create the Web pages before sending them back to the requested Web clients as part of a response. Three of the most popular Web server programs are:

a) Apache HTTP Server [19]

This is a freeware, which performs efficiently, and runs on many forms of operating systems and the related hardware that supports these systems. In addition to that, this server program has a built-in search engine, and HTML authoring tools and supports FTP. This program in easily managed using either a server console or a Web server. What makes this server program even more attractive is its ability to support Server Side Includes (SSI), Active server pages and Java Servlets.

b) Microsoft Internet Information Server (IIS) [20]

IIS comes bundled with Microsoft's Windows NT Server and 2000 Server operating systems; a variable of this server with a similar function is the Personal Web Server (PWS). This is another server that comes integrated with a search engine, and also supports FTP. Administration for this program is done via a remote browser. Besides that, ISS combines HTML pages, ActiveX components, and scripts to produce dynamic pages.

c) iPlanet Enterprise Server [21]

This server runs on a multitude of operating systems, such as, AIX,

19 http://www.apache.org/

20 E-commerce power point slide notes; *Mr.Teh Ying Wah, FSKTM, University Malaya*

21 http://www.iplanet.org/

Digital UNIX, HP-UX, Irix, Solaris and Windows NT. This server has the ability to provide a powerful development environment that supports development of Web-based applications that can run on the Internet, an Intranet, or an Extranet. With the iPlanet Web Server's management tools, administrators can manage users and monitor the server in an active interactive manner.

2.4 User/Server Architecture

A server is an computational entity that allows access to the user, so as to be able to process the commands of the user. The scenario in which this works is as stated below 22:

The user/server architecture has three major components:

i. User (Client)

The user's processes begins when the user enters a system regardless whether the users are in different systems, as long as these systems are attached to the same server. The user's processes involve sending out commands for services through the network of the server. This is to reach the server so that the server can process the tasks requested.

ii. Server

The server's processes begin at the level of a few computer systems. It will operate on its own and then will rest in intervals while waiting for commands by the user in order to start the subsequent processing.

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22 Stevens, 1990

iii. Network Connection

This refers to the cables, wires and hardware that connect the user to the server.

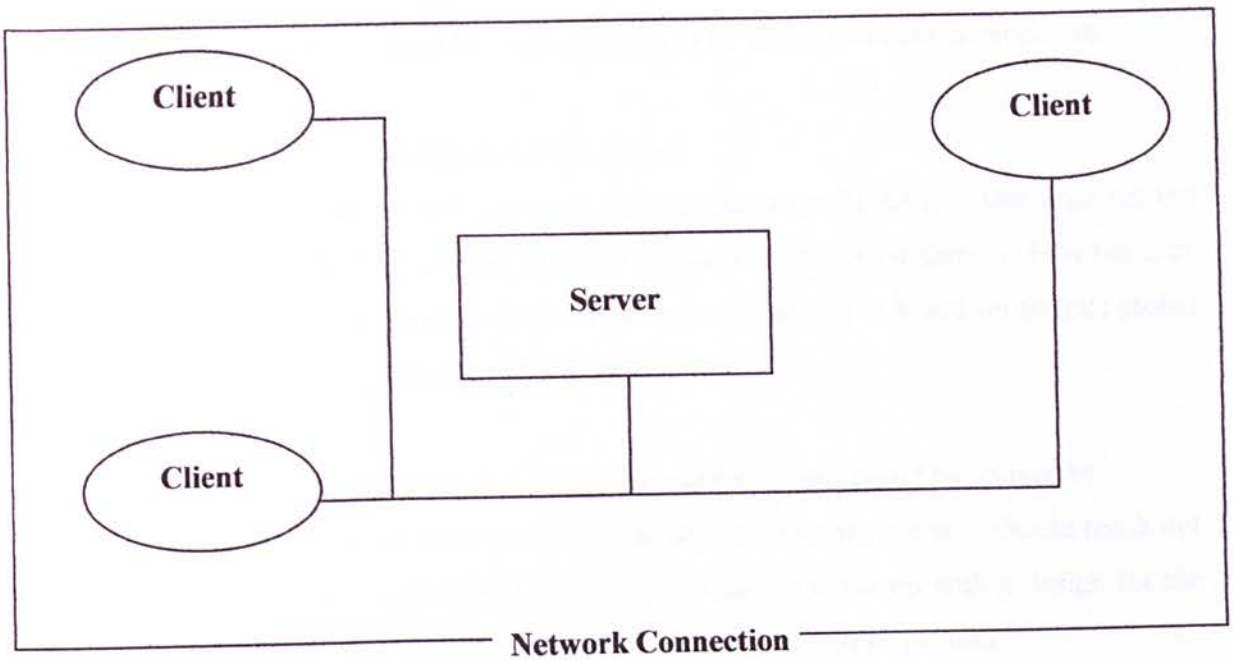

Diagram 2.1 : The user/ server architecture

2.5 Multimedia Elements [23]

This section discusses key factors that must be taken into consideration when realizing a website design. Considering the fact that web sites are usually endowed with a good amount of multimedia elements to form a seductive user interface, it is important to look into the types of multimedia elements that can help the web site administrator or web master decide on the best multimedia elements to use in building a website.

23 Mbone: Interactive Multimedia on the Internet; *Kumar, Vinay*; New Riders Publishing

2.5.1 Realizing an Idea

When developing a website, there are a few factors that must be answered, besides what elements to use in the website such as animation, graphics, video clips and so on. Some of these factors/questions to be taken into consideration are:

- What is the main objective of the web site
  The right theme is needed to relay the right message to the user that accesses the web page. The kind of look and feel of the website will determine how the user interprets the information on the website, such as if it is based on serious global issues, or if it is of lighter entertainment value.

- Who are the target users that the website information should be relayed to
  It is important to identify the main type of users that the website should reach out to. Once this is established it would be easier to come up with a design for the website that would be able to draw the attention of that target user.

- What are the needs of the web client and has that need been satisfied
  A web user must benefit from their visit to the website, so that the website's objectives can be reached, which is in most cases to provide services to the user.

- Is there a more effective way in providing such services to the client in comparison with presenting this services on a website
  Sometimes the idea that is put forward is not practical even though it does seem incredibly impressive. To avoid this, consideration must be made as to look into other alternatives, to see if the final product would reach its objectives better in another form.

- Specifications and technical implications that are involved.

A website developer must make full use of the resources in hand and also take into consideration the types of resources available to the user. This includes the kind of network, processing speed, hardware and software that might be available to the average target user. What is the point in developing a product that cannot be accessed by a user?

- What are the advantages provided by the new product in comparison with the other products that are available

  For a product to reach a level of success, it must first be put into consideration as to what its competitive element may be. The new product must have advantages that outweigh any available alternatives in order for it to have that competitive edge.

2.5.2 Graphics on the Web [24]

Graphical elements are important in presenting information to the user effectively. In this section, the types of graphical formats that is usual used over the Internet will be discussed.

2.5.2.1 PNG

PNG or Portable Network Graphic was developed by a group of graphic tools developers and not an individual or a corporation. Specific PNG is a formal

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24 Web Designer's Guide to Graphics: PNG, GIF & JPEG; *Webster, Timothy*; Hayden Books

description for a graphic file format. It explains in details how the data is stored, labeled and so on. The designer however is not interested in the specifications, but is more interested in knowing who was the developer of such PNG soft wares such as Adobe Photoshop and Microsoft Internet Explorer. The advantages of the PNG are:

- Supports many coloured models

  This enable the designer of the website to produce full colour images for the best high-end displays, in indexed colour modes (for fast download ability), or in gray scale. Unlike GIF and JPEG, PNG supports all basic colour model to produce and imagine on the monitor screen.

- High quality image compression

  This makes the image files compact and easily downloaded through the Internet connection. For example, an image that in usual cases takes up 621K bytes of disc space in an uncompressed format will now take up only 354K bytes if stored in a PNG format.

- Support for high-tech interlacing

  This helps the image to be displayed faster on the web. Interlacing is when an image that is not clear when first appeared, will gradually become sharper and more focused. Interlacing has been used since 1989 but the new breed of high-tech interlacing allows for the illusion that the image was been loaded on the website at very high speeds.

- Support for Gamma correction

  This helps correct the brightness of the image automatically when an image appears on the monitor/ the brightness of an image is different from one machine to another, and can be seen when a test in done using different platforms.

- Support of Alpha streaming

This allows the artist to create shiny images with much smoother edges. This is also known as selection masking or layer masks. PNG brings this kind of masking to the web.

- Support insertion of comments

  This allows the web designer to add text like copyrights on documents so that the user can focus on the text information. These information will later be picked up by search engines, and allow users to search for information using a new method.

2.5.2.2 GIF

GIF is the abbreviation for Graphic Interchange Format, and is a graphic format file that was created by the research and development group of CompuServe Information Service for their CompuServe online users. GIF files has existed since the 80s and is one of the earliest graphic image files that is used on the graphic based browsers such as, NCSA Mosaic and Netscape. Almost all browsers use this basic format now, and GIF formats now comes in many variations:

- Small file size

  GIF runs a computation transaction; this format supports 256 limited colours to decrease the file size as much as 25% to 30% of that from other file formats such as TIFF and EPS. During the period in which GIF was developed, a high-end monitor that could display the GIF borders were highly expensive for an average user, therefore these form of computation to reduce the file size proved to be practical.

- Internally built compressors

GIF not only reduces the file size by reducing the overall colours used in the image, but it also compresses the image automatically using a similar method to that of the Zip (Windows) program and StuffIT (MacOS) program. Nonetheless, the compressor of the PNG file format proves to be better than that of GIF.

- Transparency

  GIF format allows for simple transparency to be implemented. In other words, we get to specify certain pixels to be left out, so the background of the Web can be seen through these absent pixels space. PNG transparency is much better than that of GIF but there have been many people who pioneered and successfully used the GIF's transparency mechanism to display images in an interesting and imaginative manner.

- Animation

  GIF is special in the animation sense also, as animated GIF or GIF89a, is one of the easiest and cheapest means of adding movement to the web page.

2.5.2.3 JPEG

JPEG is the abbreviation for Joint Photographer's Experts Group isn't exactly a file format – it is more of a set of techniques to compress files. There are several files that are closely linked to the form of JPEG compression – JFIF, or JPEF File Interchange Format. In most occasions, JFIF is mistakenly assumed to be JPEG. JPEG is the compression technique optimized to handle full colour files, especially complex images like photographs that have been scanned and digital drawing. This is the reason by which JPEG was invented and it is the best in handling such functionalities. However, JPEGs are bad at handling type material (type in websites and on buttons) and line graphics (line art). The advantages of JPEG is:

- Efficient compression

  JPEG is good in compressing and reducing the size of files. However, due to the compression of JPEG, the quality of the image will also be reduced. The more the JPEG compression done, the more the blurred effect on the image.

- Progressive display

  Some versions of JPEG support progressive display. Using this method, the user can observe a gradual progressive emergence of the image, and not have the entire image displayed at once when it is downloaded into the browser. The word progressive is different from that of interlaced. Progressive images are loaded from the top to the bottom, not starting from a blur image that gradually becomes clearer, which is what happens with interlaced loading.

2.5.3 Movement

There are three major formats for creating online animation:

- Shockwave – a type of format used in Macromedia Director that allows the user to use simple graphic animations.
- Java language – a type of programming language
- GIF animation – to create GIF animation, applications such as the GIF builder is needed for Macintosh, and GIF constructor set or Flash is needed for a normal PC.

2.5.4 Audio on the Web

The implementation of audio on the web in general can be split into two formats, which are the static format and the not static, streaming format:

2.5.4.1 Static files, non streaming, downloadable

Static format file is the most popularly used format because of its easy usability and low cost for usage. But the main factor that serves as an obstacle is the huge file size. However, with the use of compression techniques such as AIFF/C and MPEG and the reduction of the audio quality, these audio files can be placed on the web ready to be downloaded. The static format can be used to store any type of sound and is flexible and does not need special browser software. All forms or types of audio appliances supports these static file formats especially the most popular, which is the AIFF and WAVE. There are several main static forms that are used today which are:

- WAV

  Also known as Waveform Audio File Format, this is the original format used by Windows and is the most popularly used on the Internet. IDM and Microsoft has developed a section of specifications known as RIFF (Resource Information File Format) to be used with various files used on Windows. The usual format used is PCM (Microsoft Pulse Code Modulation), which uses logarithm coding. WAV supports arbitrary sampling and multiple channels.

- MPEG (MP3)

Developed by the Motion Picture Experts Group and is a format which is very popular now. This is a format specially used for audio but it an automated compression mechanism that compresses at a rate of 4:1.

2.5.4.2 Streaming Technology

Streaming software is split into three components, which are the coder, server and user. The coder changes audio from the source to a form of stream. The source can be an already available .wav audio file or be in the midst of processing by the computer audio card. The browser will make available the stream output or the file that can be streamed, available to the user.

2.6 Case Analysis

There are several websites or online products that have similar elements to that of the suggested project. Below is the list of some of these websites that offer E-Learning and the differences from these with the proposed project.

2.6.1 MedicalStudent.com [25]

This website bases its objectives on the quote "The student begins with the patient, continues with the patient, and ends his studies with the patient, using books and lectures as tools, as means to an end" [26]. As noted by the esteemed physician Sir William

Osler, he believed that learning was an apprenticeship, and that convenient access to information was vital to medical apprentice learners to help them along in their studies. In this regard, MedicalStudent.com, proves to be an impressive databank of authoritative medical information that serves as a digital bank that is modeled to help all students of medicine.

The goal of MedicalStudent.com is to enlighten, entertain and educate on the Internet. To accomplish this, it not only has a vast database of medical information, but identifies varies web pages online with relating information and hyperlinks the user to the mentioned sites. Essentially, MedicalStudent.com serves as a "pico portal" for students who are seeking medical resources via the Internet.

What makes this site even more impressive is that it adheres to the World-Wide Web criteria for site selection, which are:

1) The site is selected by a process of peer review by accreditation, because accreditation models are designed for works that change over time. To become accredited, a site must clearly display four core quality standards:
    a. **Authorship**, including the author's name, affiliation, and credentials.
    b. **Attribution** of facts through the listing of references.
    c. **Disclosure** of site ownership and sponsorship.
    d. **Currency** of the site by listing dates of content posting and updating.

2) The site must provide free services to the user, partially or as a whole
3) The website should be coded using the Hypertext Markup Language format (HTML), so that the users will be able to access it using the lowest common denominator which is the World-Wide Web browser.

The weaknesses of this website in comparison with the proposed project:

a) The information on the site is not phrased in a way that will help students to understand the knowledge that is being relayed by these information. In other words, the information on the website, are in a format that has likeliness to that

found in the text books and serves better as a reference rather than a means of 'teaching' students.

b) The site does not have tests or exams for the students to use as an excessive or test their level of understanding.

c) The site lacks multimedia elements, such as graphics or animation that can help explain the information on the website. These elements are also important to keep students keen and interested, as non-text based education has proven to increase the attentiveness of students in learning, as it keeps the student interested and motivated.

2.6.2 ExamsOnline.com [27]

This is a business based website that provides certification and assessment services such as exam preparation, pre- and post-assessment in the filed of IT. The services provided in this website is based on The Alliance Partner Program, that is targeted at Training Centers, Colleges and Universities, Consulting firms and Fortune 1000 companies. ExamsOnline.com offers these services in three types of payment partnership, which is categorized as Silver, Gold and Platinum. These categories, provide different levels of services to meet the different requirements of various kinds of organizations.

25 http://www.MedicalStudent.com
26 Sir William Osler, Aequanimitas, 1905

Prior to the company's online venture, ExamsOnline.com provided its assessment and certification services via CDs. But with the emergence of the Internet as a popular platform for information exchange, ExamsOnline.com now operates its business via the Internet, by making these services downloadable to the buyer. This form of E-commerce has proven to be beneficial to the buyer as the cost of online transaction is reasonable and often less than that of the conventional form of sales (through the retailer etc), as it cuts operational costs and such transactions can usually be accomplished in a faster and much easier way through user-friendly interfaces.

ExamsOnline.com provides test exercises and simulation for candidates who will be sitting for IT certification examinations. These include major IT providers such as Microsoft, CompTIA, Oracle, Novell, and Red Hat. The tests are relayed to the user in a basic functional program that depicts the real operational environment, which doesn't require the purchasing of expensive Operating Systems. The services that can be bought includes a grading mechanism that assesses the level of IT ability possessed by the candidate based on their achievement in the tests. Thus, the soft wares provided by ExamsOnline.com proves to be a good corporate tool, as it helps organizations to test the level of ability in their employees in the field of IT to establish their capabilities and the area in which they may need more training.

The weaknesses of this website in comparison with the proposed project:

a) The website does not provide tests for medical students, as mentioned earlier the exams provided are exclusively for those in the IT industry or the computer based industry.
b) The model used in this website seems to be appropriate to be used in the proposed project (based on the free sample exam provided on the site), except for the fact that it does not serve to provide information to the students, such as tutorials and references.
c) The services provided by the website does not provide test in a level by level method, so as to test the student's understanding constantly, but serves more as a

final assessment; this is not conducive for medical students who need to be evaluated constantly.

d) The soft ware provided by the website is not scalable in comparison with the proposed project. The proposed project allows for expansion by using the Administrative Console web page to add new information and test questions. This makes the proposed project more dynamic and accommodating to the constant changes in the medical field.

2.6.3 E-Lab, Wayne State University School of Medicine [28]

E-Lab is equipped case analysis, pictures, interactive tests and others. Certain units are only available after the topic has been taught in the classes in the university. The access of the information on E-Lab is also protected by login name and password. This application is advanced and highly appropriate for medical students.

The weaknesses of this website in comparison with the proposed project:

a) The website is only accessible to students of Wayne State University that are equipped with an assigned login name and password

b) The information needed by the student is not always available, as it is only uploaded after it has been taught during classes. This takes away the option of using such materials for preparation prior to when the class is run. It also means that this material will not be available for those who have studied ahead and would like to use the topic information for revision.

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27 http://www.ExamsOnline.com
28 www.med.wayne.edu/elab/

c) The lack of references on the website for the use in labs, also means that the students will still have to depends on their lecture notes and text books. Thus, it doesn't take away the problem of students having to carry about heavy books.

2.6.4 Online Biochemistry tutorials [29]

The purpose of an online medical tutorial is to allow students in the field of medicine or other health science related fields, to grade their knowledge in biochemistry and other related topics, to establish their ability to use this knowledge in a basic clinic environment. The knowledge required for this, is estimated to be at the level of that of a biochemistry student.

In light of that, this website provides the basic information needed based on the above standards, and is structured in a manner to encourage students to be self-taught. In some tutorials, students are required to follow a series of information on web pages that are linked back to back, while on other instances, the tutorial allows the freedom and flexibility for the students to browse for information in areas preferred. For each of the separate tutorial modules, questions are posed in different sections of the tutorial to serve as a form of exercise for the students. Some of the questions are in multiple-choice format but some require for written answers. If the answer given is wrong, the program would generate almost similar but simpler questions, until it reaches a point when the student answers correctly; this is to establish the level of understanding possessed by the student.

The website calls for students to identify problems faced and in some cases take part in therapeutic management. This is method where the student will evaluate and test himself or herself, support, make adjustments and corrections according to the instructions provided. This tutorial can be downloaded into a Macintosh using the .hqx format and must be compressed using the Stuffit Expander or any other soft ware

with the same function. Some of the tutorial can be run online without any other requirements.

The weaknesses of this website in comparison with the proposed project:

a) This website has information that fits the syllabus of biochemistry students more than it does medical students. Knowing basic knowledge to function in a clinical environment is not enough for medical students as the medical syllabus runs deeper than that.

b) The basic concept of using slides of questionnaires to test the level of understanding in medical students is appropriate and supported by the proposed project. However, the proposed project has the added advantage of animation and related multimedia elements, plus and almost immediate feedback of the students performance in the test.

c) Does not posses different levels of grading the student. This will help students acknowledge the level of understanding that they are at, so that they can improve themselves in these specific areas.

2.6.5 The Interactive Patient, Marshall University School of Medicine [30]

This application generates a simulation of a scenario of a doctor attending to a patient. This teaching tool is meant for the use of doctors, residents, and students, as a form of practice in dealing with a real patient. The application allows the user to interact with the patient, and ask questions about the patient's complaint regarding their sickness, and subsequently interact with the patient to find out supplement details such as their medical history. The application also allows the user to run physical tests, run various lab tests, and perform X-rays on the patient. Once this is done, the application will encourage the user to make a diagnosis, and form a plan to treatment based on the

information extracted. All the answers given will be evaluated and a feedback will be provided after a given time.

The weaknesses of this website in comparison with the proposed project:

a) The website does not provide any references or tutorials before interacting with the 'patient'.

b) This application is good for practice but not for teaching.

c) A student who does not posses the required knowledge would not be able to use this website effectively.

d) The feedback that comes at the end of the session will take time, as a lecturer must manually attend to it. The time and effort needed is inappropriate, as the student would not only have to wait for their feedback, but the application would also require enough experts in the field to correct every diagnosis that comes through from students.

29 http://www.umanitoba.ca/faculties/medicine/units/biochem/coursenotes/blanchaer_tutorials
30 http://www.medicus.marshall.edu/medicus.htm

CHAPTER III

METHODOLOGY

3.1 Methodology

Software Engineering provides many types of software process models to provide the system developer an idea of the sequence of methodology to take as a form of development strategy. The software process model selected for this project is the Waterfall model because of practical reasons, such as it presents a very high-level of what goes on during development, and suggests to the developer the sequence of events they should expect to encounter.

The other benefits of this model:

- Its sequence of event is clear and easy to explain, making it easy to identify what a developer need to do in order to construct the proposed system.
- It is easy to associate each milestone with its deliverables.

Phase 1 : Requirement Analysis

Analyze the requirements needed to form a useful system and to identify the key needs of the system that is to be developed. This process involves the literature review done to identify key reasons to propose and develop the system; this in turn will help identify the system requirements. Once the requirements have been identified, an analysis is done to weigh items such as feasibility and importance of each requirement. The justification for each requirement and how to implement these requirements in the system can be obtained from interviews with potential users or references into system development references.

Phase 2 : System Design

This is an overall look at each module that makes up a systems design.

Phase 3 : Program Design

A closer look at the design of each module or the program of the system.

Phase 4 : Coding

The actual coding of the system, which involves linking the user interface with the databases in the back end of the system. Two major languages used for this system is Active Server Pages (ASP) and Hypertext Markup Language (HTML).

Phase 5 : Unit & Integration Testing

This phase tests the coding done in the previous phase at its unit level (function-by-function or webpage-by-webpage), and also its integrated level, which is testing if each unit of the system can work together is the function calls for it.

Phase 6 : System Testing

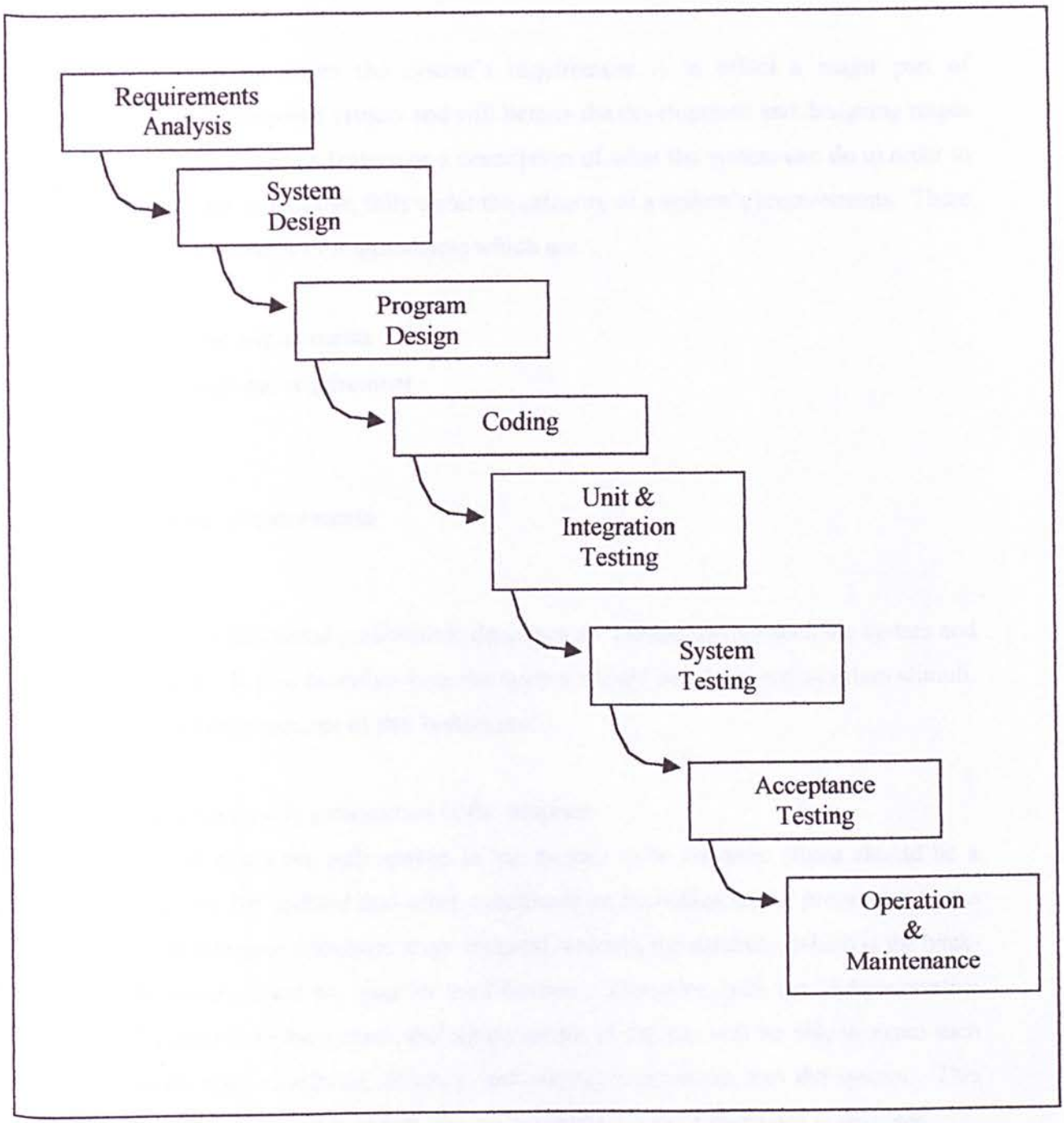
Testing the function of the entire system to make sure that it fulfills the system's requirements and needs.

Phase 7 : Acceptance Testing

The system is used by a target user, to see its level of acceptance; this phase is important, as it will determine how well a system does once it has been released in the market.

Phase 8 : Operation & Maintenance

This is the final stage of the development, which is the final implementation of the system, and its subsequent maintenance work once the system has been used by the target user.



Waterfall Model (Methodology)

3.2 System Requirements

Listing down the system's requirement is in effect a major part of understanding the proposed project and will help in the development and designing stages of the project. A system's feature or a description of what the system can do in order to fulfill its functions or purpose, falls under the category of a system's requirements. There are two types or sections of requirements which are:

- Functional requirements
- Non-functional requirement

3.2.1 Functional requirements

A functional requirement describes the interaction between the system and its environment. It also describes how the system should behave given a certain stimuli. The functional requirements of this system are:

(a) Ability to modify information in the database

In order to allow the information in the system to be dynamic (there should be a module to allow for updated and other modifications according to the progresses in the medical field that have relevance to the medical student), the database, which is the back-end of the system, must be open for modification. Therefore, with the 'Administrative Console' available in the system, the administrator of the site will be able to make such modifications such as editing, deleting, and adding information into the system. This modification function will however only be available if a valid password is provided.

L.P Shari, *software Engineering and Practice*. Upper Saddle River, New Jersey, Prentice Hall International, 1998

(b) Changing of passwords and editing of personal information

A student can change his/her password when the need arises and will also have the option of changing personal information when and if there is a need for it.

(c) Search engine

The students that use the site to access the medical information within the site use this search module. The search engine will help students look for specific information from the information database and display the results to the student to save the student time in accessing this information.

3.2.2 Non-functional requirements

A non-functional requirement describes the kind of obstacle or constraints that restricts the systems ability to find a solution to the problem at hand or to function in an optimal level. These constraints usually narrow the selection of language, platform or implementation techniques or tools. The non-functional requirements of the system are:

(a) Graphical user interfaces

Graphical user interfaces (GUIs) are essential in attracting users to want to use the proposed system. A good GUI design will ease the use of the system and not demand for the keying in or commands for example. Hence, this will enable users with little or no technical background to be able to operate the system well.

(b) Security

For the system to prove to be beneficial and applicable the information within the system must be protected from outside intervention and corruption. Therefore, only administrators with the valid username and password will be allowed to modify the information within the system.

3.3 Hardware and software requirements

In the implementation of the proposed project, picking the right hardware and software is crucial in determining that the system built will function in an optimal level. Therefore a proper analysis has been done in order to determine the right hardware and software needed in building the proposed system.

3.3.1 Hardware requirements

One of the key aspects in determining the effectiveness and reliability of the proposed system is the hardware in which it will run from. This is an important aspect to take into account as it will determine the long-term functionality of the proposed system. Below are the suggested hardware, which fits the minimum specification, and also the hardware that is expected to produce the maximum performance of the system.

3.3.1.1 Server

Minimum specification

- Intel Pentium III 500 MHz or other compatible products
- 256MB SDRAM @ 133 MHz
- SCSI-2 Hard Disk Drive 18.2 GB or any UDMA-100 capable drive
- Any 100 Mbps Network Card
- Standard integrated peripherals

Optimal specification

- Dual Pentium III 800MHz system
- 512MB SDRAM @ 133MHz
- SCSI-2 Hard Disk Drive 32 GB or any UDMA-100 capable drive
- Any 100Mbps Network Card
- Standard integrated peripherals

3.3.1.2 Client or User

Minimal specification

- Intel Pentium 200 MHz or other compatible products
- 64MB SDRAM @ 66MHz
- Hard Disk Drive 4.3 GB
- Any 10/100Mbps Network Card
- Standard integrated peripherals

Optimal specification

- Intel Pentium II 450MHz
- 64MB SDRAM @ 100MHz
- Hard Disk Drive 6.4GB ~ UDMA-66
- Any 10/100Mbps Network Card
- Standard integrated peripherals

3.3.2 Software requirements

- *Macromedia Authorware 5.0 Attain*

  Macromedia Authorware Attain 5.0, is one of the most popularly used authoring tool for developing online web-based learning systems. Authorware provides the functions that give the developer the ability to:

  - Build a learning application interacts with various forms of media
  - Build a system or application that can be distributed to the user via the Internet, through a computer network or be burnt into a CD-ROM.
  - Index the students answers, in order to keep track of a student's test results and progress in an education software.

Authorware 5.0 Attain is a segment of the Attain Enterprise Learning System, which provides complete online education solutions, which includes the functions to develop, and manage an education based learning application.

Local Area Network (LAN), intranet and Internet gives a flexible access to information. Therefore, these platforms prove to be an effective and efficient way to distribute the program developed my Authorware, such as interactive multimedia, exercise applications, human resource information kiosks, online magazine and others.

Besides that, Authoware also provides the functions as stated below:

- Streaming technology that enables the Authorware application to be downloaded and run on a browser such as MS Internet Explorer and Netscape Navigator.

- Services that allows for external content to be accessed via links through the URL and also provides for the complete FTP (File Transfer Protocol) functionality.

- *Macromedia Dreamweaver Ultradev v4.0*

  This is a software used to help website developers build a quality website, with the help of built in functions, that allows the developer to pick out features for the website without having to code the features desired. Besides that, it also contains functions that helps make the website that is developed with this tool more dynamic, such as generating ASP codes to link to databases in the back-end of the website interface. This software is best used for the construction of web applications that are large scaled and rely on the use of databases.

- *Internet Information Server 5.0 (IIS) or Personal Web Server (PWS)*

  The IIS and PWS functions as a web server, which will be used as the platform in which the system is built upon. This web server has security features that make it reliable, it allows for ASP transactions, has the ability to integrate the use of a search engine, and has an efficient management system that supports the full HTML standards. This web server comes with Microsoft Windows 2000 Server Professional.

- *Internet Explorer 5.0*

  Internet Explorer 5.0 is the browser needed to display the developed system via the Internet; enabling the access of the online user.

- *Microsoft Windows 2000 Professional or Microsoft Windows 95/98/ME*

  Microsoft Windows 2000 Professional is to be used by the developer to develop the proposed system. This is the choice for the server-side operating system, as it is the platform for the Internet Information Services, which functions as a web server. However, Microsoft Windows 95/98/ME can also be used by plugging in the Personal Web Server into its system from an operating system that has the PWS plug-in.

- *Microsoft Windows 95/98/ME*

  Microsoft Windows 95/98/ME is the operating system to be used on the user's computer.

- *Microsoft Access 2000*

  Microsoft Access 2000 is the database software to be used for the proposed project. This software will be used to manage the data input on the proposed system, such as the student's personal details. The integration of ASP in this software is very easy making it very suitable for websites using small-scale databases.

- *Microsoft FrontPage 2000 (Optional)*

  Microsoft FrontPage 2000 can be used during the development stages of the system, as a HTML code editor.

- *Microsoft Index Server*

  Microsoft Index Server is the software that will be used to create the search engine in the proposed system that will be used to help the student look for specific information in the encyclopedia of the proposed system.

3.4 Conclusion

The methodology chosen for the development of the system is the Waterfall model for the reasons below:

- Its sequence of event is clear and easy to explain
- Easy to associate each milestone with its deliverables

The functional requirements are:

- Ability to modify information in the database
- Changing of passwords and editing of personal information
- Search engine

The non-functional requirements are:

- Graphical user interfaces – establishing the criterion that defines a good GUI.
- Security – protection from unauthorized corruption and intervention

The hardware requirements are split into two sets, which are the minimal and optimal specifications on the server side and the side of the user.

The soft wares required are:

- Macromedia Authorware 5.0 Attain
- Macromedia Dreamweaver Ultradev v4.0
- Internet Information Server 5.0 (IIS) or Personal Web Server (PWS)
- Internet Explorer 5.0
- Microsoft Windows 2000 Professional or Microsoft Windows 95/98/ME
- Microsoft Access 2000
- Microsoft Index Server

CHAPTER IV

SYSTEM DESIGN

Design is a creative process of transforming the problem into a solution; a description of the solution is also called design. The design of a system is split into two main categories, which are the conceptual design and the technical design. The conceptual design will give a graphical and textual explanation of what the proposed system will do when it is finally implemented, and the technical design allows the system builders to understand the actual hardware and software needed to solve the customers' problems. These two designs document will describe the same system in two different ways, because of the different audiences to each document; the conceptual design would be important to the target user and the developer, while the technical design would interest the system builders1.

To achieve a good design and quality software, three characteristics that serve as a guide for the evaluation are suggested 2:

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1 L.P. Shari, *Software Engineering : Theory and Practice.* Upper Saddle River, New Jersey, Prentice Hall International, 1998.

2 R. McGlaughlin, "Some Notes on Program Design", *Software Engineering Notes,* Vol. 16, no. 4, 1991, pg.53-54

- The design must implement all of the explicit requirements contained in the analysis mode, and it must accommodate all of the implicit requirements desired.
- The design must be easily understood and be readable to the parties involved in generating the code, test the system codes, and subsequently maintain the system; where the design would serve as a guide to these parties.
- The design should provide a complete picture of the system, addressing the data, functional and behavioral domains from an implementation perspective.

This chapter will mainly discuss the design of the 'E-Learning : Encyclopedia of the Human Body' system in terms of:

- Architectural design
- System Functionality design
- Database design
- User Interface design

4.1 Architectural Design

The primary objective of architectural design is to develop a modular program structure and represent the control relationship between modules 3. This architectural design will link the system requirements specification with the system components that will fulfill these requirements and give the system such capabilities. Components are usually modules and the architectural design will give a graphical view of the interconnection of these modules. In addition, the architectural defines operations that create systems for subsystems.

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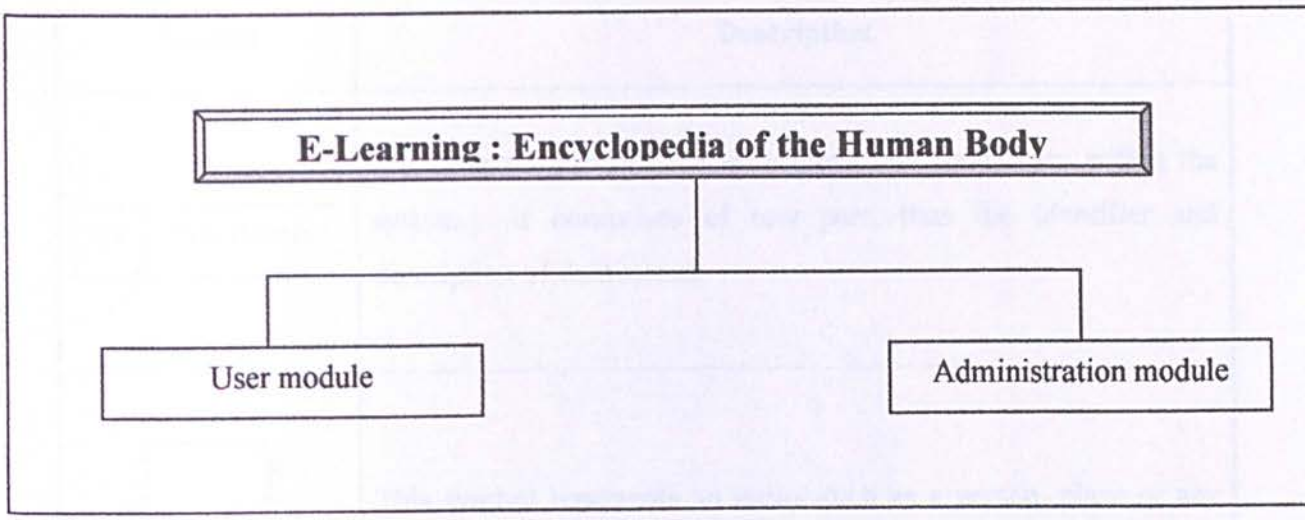
3 R.S. Pressman, *Software Engineering : A Practitioner's Approach.* New York, McGraw-Hill, 1992.



E-Learning : Encyclopedia of the Human Body Architecture

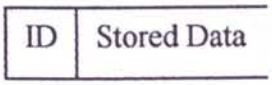
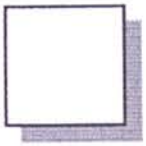
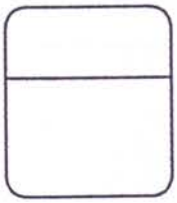
4.2 System Functionality Design

As illustrated above, the system is split into two main modules, which are the user module and the administration module. This section will discuss the functionality of each module and the data flow diagram (DFD) of each module. DFD is a method to illustrate how data flows in a system 4.

Below is a table describing the types of symbols and its function in a data flow diagram:

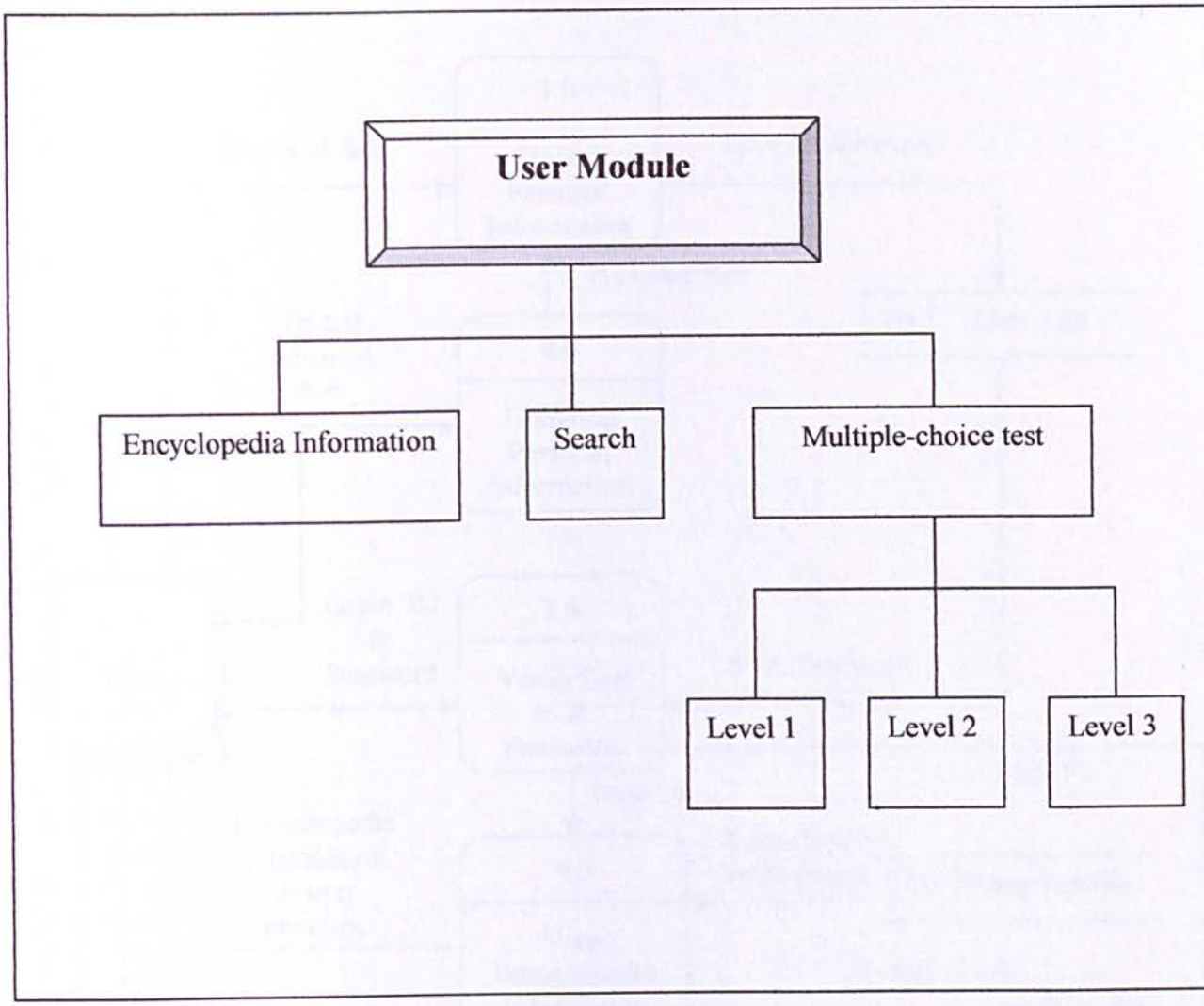
Symbol	Description
Data →	This symbol represents the *data flow* from one object to another. The arrow denotes the data flow direction. Label is used to indicate name of the information in the flow.

4 Igor Hawryszkiewycz, *Systems Analysis and Design.* Sydney, prentice Hall International, 1998.

Symbol	Description
	This symbol portrays the *data store* that holds data within the system. It comprises of tow part, thus the identifier and description of data stored.
	This symbol represents an *entity* such as a person, place or any object.
	This symbol represents a process. Process involves transformation of input data and output data. It consists of two portions. The top portion stores the identifier information. Description of the process is kept in the middle section.

4.2.1 User module

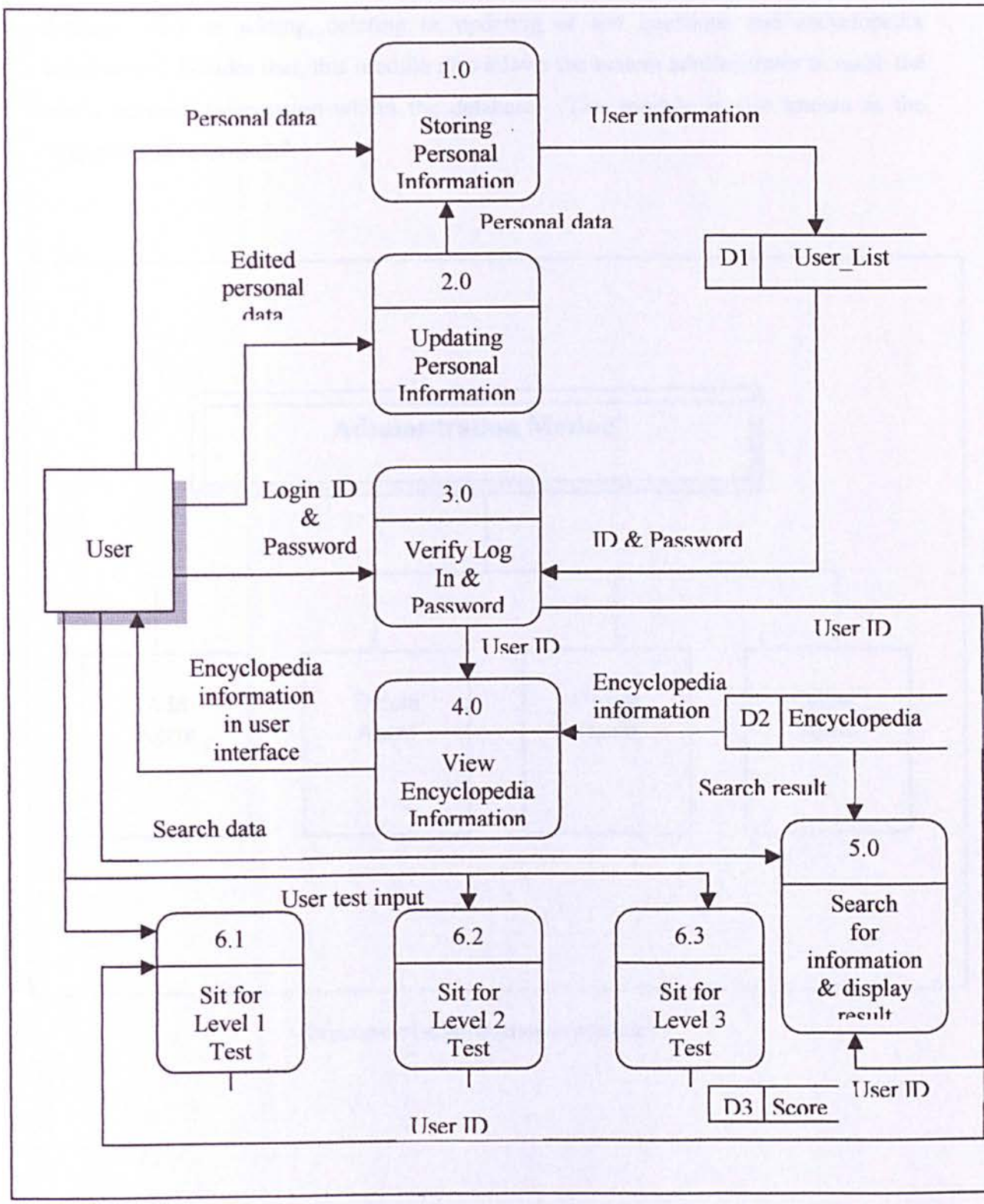
The functions provided by this module allows the user to log on to the system and view the encyclopedia information within the system, search for specific information in the encyclopedia, and take a three level multiple choice test. Below is the structure of the user module of the 'E-Learning : Encyclopedia of the Human Body' system:



Structure of the user module

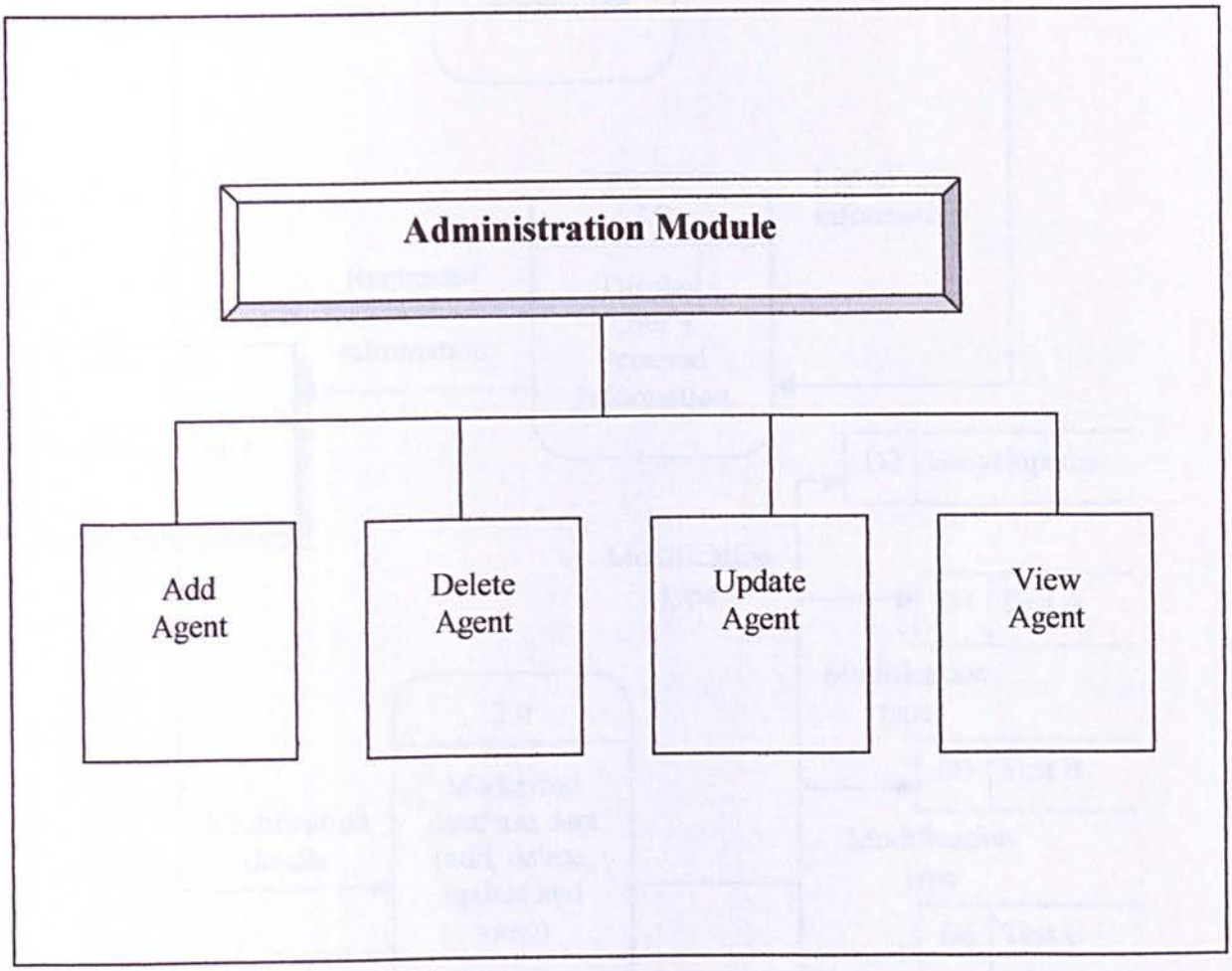
Data Flow Diagram

The DFD for the user module is illustrated as below:



4.2.2 Administration module

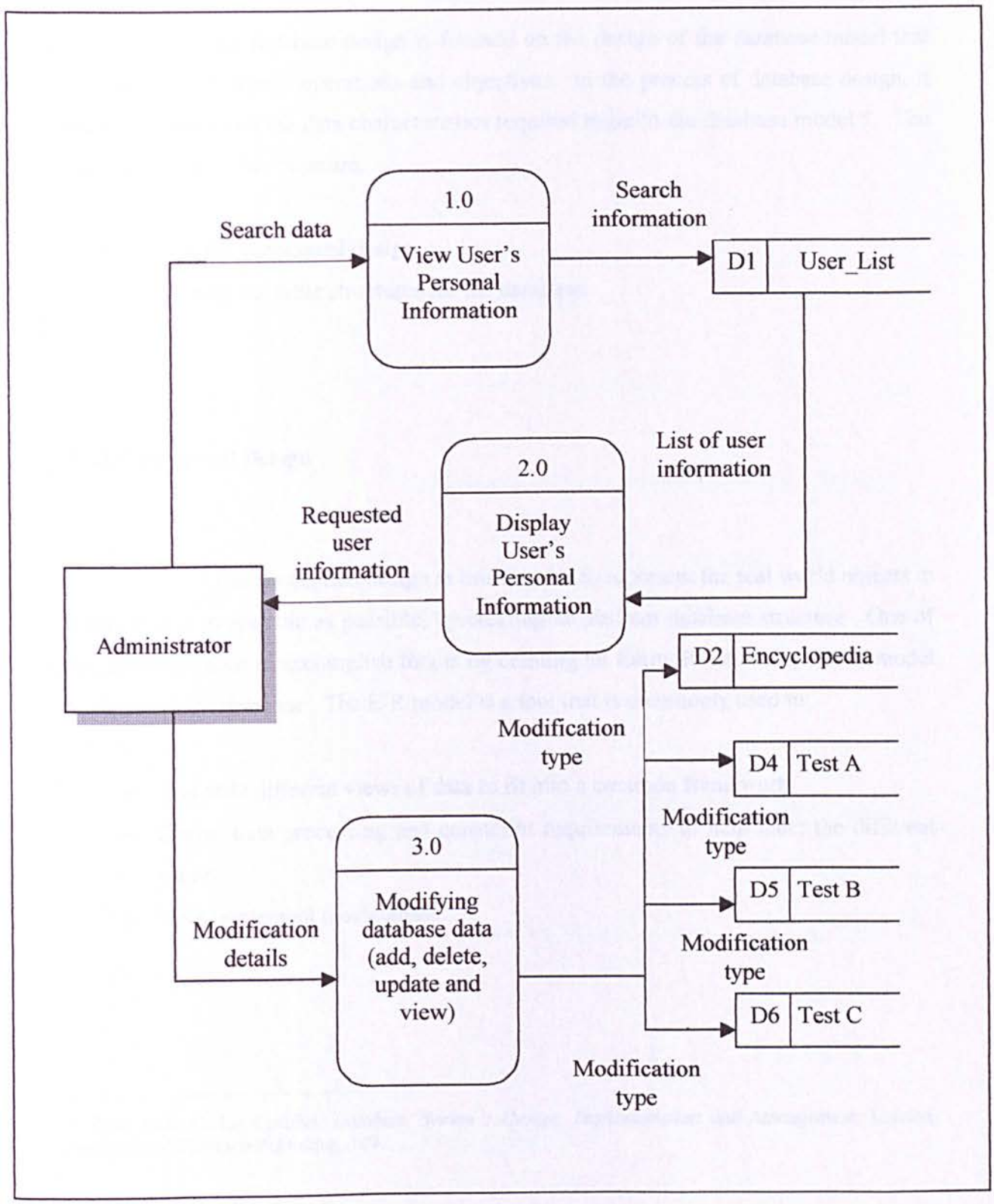
The functions provided under this module allow administrator to make changes to the database, such as adding, deleting or updating of test questions and encyclopedia information. Besides that, this module also allows the system administrator to reach the user's personal information within the database. This module is also known as the 'Administrative Console'.



Structure of administration module

Data Flow Diagram

The DFD for the administration module is illustrated as below:



4.3 Database Design

The database design is focused on the design of the database model that will support the system operations and objectives. In the process of database design, it must concentrate on the data characteristics required to build the database model 5. The main activities at this stage are:

- Create the conceptual design
- Designing the table structures for the database.

4.3.1 Conceptual Design

The conceptual design at this stage is to represent the real world objects in a way that is as realistic as possible, by creating an abstract database structure. One of the methods taken to accomplish this is by creating an Entity-Relationship (E-R) model to represent the database. The E-R model is a tool that is commonly used to:

- Translate different views of data to fit into a common framework.
- Define data processing and constraint requirements to help meet the different views.
- Help implement the database.

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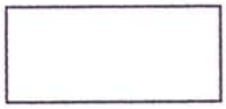
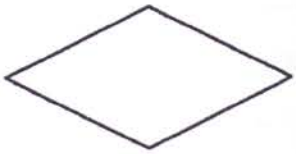
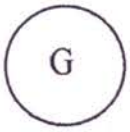
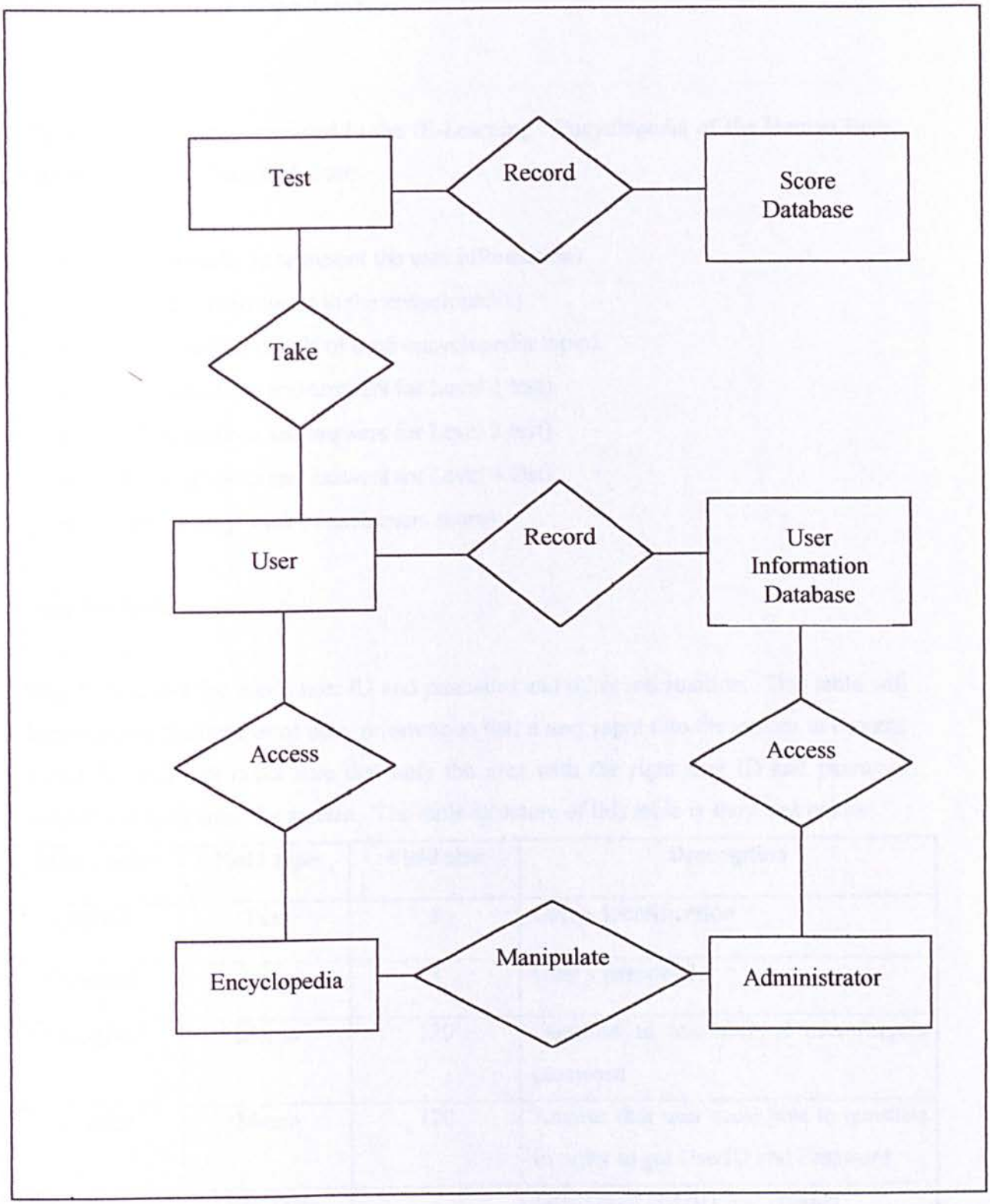
5 Peter Rob, Carlos Coronel, *Database System : Design, Implementation and Management.* London, International Thomson Publishing, 1997.

Below is the symbols used in an E-R model:

Symbol	Representation
	This symbol represents an *entity* such as a person, place or any objects.
	This diamond symbol portrays the *relationship sets.*
	The line symbol represents *link* or *relationship* between the entities.
	This symbol represents *subset* relationship between two entities



E-R model of system

4.3.2 Table structure in the database

There are seven tables involved in the 'E-Learning : Encyclopedia of the Human Body' system database. These tables are:

- User_list table (to represent the user information)
- Encyl (the main topics in the encyclopedia)
- Encyl_Info (the details of each encyclopedia topic)
- TestA (questions and answers for Level 1 test)
- TestB (questions and answers for Level 2 test)
- TestC (questions and answers for Level 3 test)
- Score (to keep track of each users score)

User_list table

This table stores the user's user ID and password and other information. This table will keep track of the number of user, information that a user input into the system to become a member and will make sure that only the user with the right user ID and password would be able to enter the system. The table structure of this table is shown as below:

Field name	Field type	Field size	Description
UserID	Text	8	User's Identification
Password	Text	8	User's password
Question	Memo	120	Question to ask user, if user forgets password
Answer	Memo	120	Answer that user must give to question in order to get UserID and Password
DOCreation	Date/Time	-	Date when UserID was created

Encyl table

This table lists down the main topics available in the encyclopedia and creates links to the each of the related topic information. It also stores related pictures.

Field name	Field type	Field size	Description
En_ID	Number	3	The topic identification number
Topic	Text	50	Title of the topic
Dir	Hyperlink	-	Directory address
F_Name	Text	50	File name

Encyl_Info

This table stores the detailed information of the encyclopedia according to its main topics.

Field name	Field type	Field size	Description
En_ID	Number	3	The topic identification number
Pnum	Number	3	The paragraph number
Info	Memo	-	The detailed information of the encyclopedia.
Pict	-	-	The related pictures for the paragraph

TestA, TestB, and TestC table

This three table stores the test questions and answers and other related information. Test A are for questions for the first level, Test B are for questions for the second level and Test C are for questions for the third levels. The level of difficulty for each level varies with level one being the easiest, level two having mediocre difficulty and level three being the most difficult of the three.

Field name	Field type	Field size	Description
QID	Number	3	The question identification number
QContent	Memo	-	The test question
C1	Memo	-	The first choice of answer for the multiple choice question
C2	Memo	-	The second choice of answer for the multiple choice question
C3	Memo	-	The third choice of answer for the multiple choice question
Ans	Text	3	The answer to the question
Status	Number	2	The status of the question, whether it is activated (1) or not activated (0).
DOActivation	Date/Time	-	Date when the question was activated in the system.
DODeactivation	Date/Time	-	Date when the question was deactivated in the system.

Score table

This table keeps the test scores based on the UserID. Each item on the table will keep score of the number of correct answers the user has picked. This table is scalable when necessary; extra columns can be added by the administrator if the situation calls for it, i.e., the number of times the student fails to reach the minimum score to advance to the next level, increases.

Field name	Field type	Field size	Description
UserID	Text	8	The ID of the user taking the test.
TL1	Number	2	Score of user for the first level test on the first try.
TL2	Number	2	Score of user for the first level test on the second try.
TL3	Number	2	Score of user for the first level test on the third try.
BTL1	Number	2	Score of user for the second level test on the first try.
BTL2	Number	2	Score of user for the second level test on the second try.
BTL3	Number	2	Score of user for the second level test on the third try.
NTL1	Number	2	Score of user for the third level test on the first try.
NTL2	Number	2	Score of user for the third level test on the second try.
NTL3	Number	2	Score of user for the third level test on the third try.

4.4 User Interface Design

Graphic User Interfaces (GUIs) are used to determine the best possible user interface for the system. Considering the fact that the system is meant to be set online or is a web-based system, the interface must be attractive to attract the users attention, but at the same time must be practical and easy to use, as it is an e-learning software for users without very technical backgrounds. The easier the user interface is to understand, the better it is to relay educational information to the student. The Human Computer Interface (HCI) general principles of designing an interactive system is shown in the table below 6:

Principle	Description
Consistency	Consistent format for command input, data display, menu selection, and placing of the control objects.
Confirmation and Verification Message	Ask for verification for any non-trivial destruction such as delete a record.
Recoverability	Ability of the user to take corrective action once an error has been recognized.
Forgive mistake	The system should protect itself from user error that might cause it to fail.
Reverse Action	Allow user to return to the previous state (before change).
Functions Grouping	Categorize activities by function and organize screen geography accordingly.
Simple Command Name	Use short and meaningful code to name commands. Short name is easy to memorize and reduce typing mistake.
Responsiveness	How the user perceives the rate of command with the system. For example the mouse pointer changes to hourglass or displays a wait message when the system is processing data.
Context-sensitive Help	Provide relevant help topic for current state, when user needs the Help system.

Because the proposed e-learning system is fairly simple to understand, many of these HCI principles have been deemed unnecessary, but nonetheless some of the HCI principles were incorporated.

4.5 Conclusion

The system is split into two modules, which are the user module and the administrative module. Each module can be elaborated and better understood through architectural designs, which involves data flow diagrams, and through conceptual designs, which includes the creation of an Entity-Relationship Diagram. Establishing the structure of the database that will be used for system will also make the development process more organized and better prepared for. Establishing and taking into account all the criterion that make a good GUI is also important especially since the system is to be used by users from a non-technical background.

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6 C.L. Hendrick, *Introduction to the Internet Protocol,* [1996?] gopher://gopher-chem.ucdaris.edu/11/index/internet-aw//Intro_the_Internet/intro.to.ip.

CHAPTER V

SYSTEM IMPLEMENTATION

5.1 Introduction

System implementation involves the translation of the software representation produced by the design phase into a computer-readable form. This phase would then involve converting the systems requirements and designs into program codes. During the implementation of the system, some modification may also be made to the initial design of the system. System testing would then evaluate the system according to the initial set of requirements. E-Learning : Encyclopedia of the Human Body, is developed using the top-down approach which involves building the high-level software modules which are refined further into functions and procedures.

5.2 Development Environment

5.2.1 Hardware Configuration

- Intel Pentium III 500 MHz or other compatible products
- 256MB SDRAM @ 133 MHz
- SCSI-2 Hard Disk Drive 18.2 GB or any UDMA-100 capable drive
- Any 100 Mbps Network Card
- Standard integrated peripherals
- Other standard desktop PC components.

5.2.2 Software Tools (refer table on the next page)

5.2.2.1 Tools for system design and report writing

During the beginning processes of building the system, namely the system analysis and design phase, Microsoft Word 97 and Visio Professional 5.0 were used to draft out and draw flow diagrams, system structure chart and to capture other system requirements of the e-learning software.

5.2.2.2 Tools for System Development

The right kind of system tools is vital in the development of the system. The table below lists out the software used for the development of the e-learning software:

Software	Module	Description
Macromedia Dreamweaver Ultradev v4.0	System Requirement and Interface Design	Web page coding and Image design
Internet Information Server 5.0 (IIS) or Personal Web Server (PWS)	System Requirement	Web Server
Internet Explorer 5.0	System Development	Web page design
Microsoft Windows 2000 Professional or Microsoft Windows 95/98/ME	System Development	Operating System and Web page coding and design
Microsoft Access 2000	System Development	Database design

Software Tools for Development

5.3 Database Development

The software tool used for the database design is Microsoft Access 2000. This software is easy to use where building database of small and moderate volume is concern. Relationships between the tables within the database are also easily constructed with this software and modification of the tables, data and relationships alike is also almost effortless with Microsoft Access.

5.4 Program Coding

Coding is the process used to develop the detailed design representation of the software into a working software. By using the Interdev tool in the Dreamweaver software, many software functions can be implemented using the built in procedures within the Interdev.

5.5 Testing

Before the software is operational to the end use, it should be verified and validated, and that is what the testing process is for. Verification is the process or set of activities that evaluates if the software correctly a specific function. As for validation, it is a different set of activities that ensures that the software has been built inline with user requirements. Software testing is indeed an essential part of software development as it focuses on software quality assurance and represents the ultimate evaluation or review of the system's requirement specifications, design and coding. The objectives of testing can be stated as follows:

- Testing is a process of executing a program with the explicit intention of finding errors, that is, making the program fail.
- A good test case is one that has a high probability of finding an as yet discovered error.

- A successful test is one that uncovers an as yet undiscovered error.[1]

5.5.1 Testing Techniques

Two techniques were employed in the testing process, namely the white box testing and the black box testing.

5.5.1.1 White Box Testing

White Box testing uses is a test case method that uses the control structure of the procedural design to derive test cases. Using white box testing, test cases were derived with the purpose:[1]

- Executing at least once all independent paths within a module.
- Exercising all logical decisions on their true and false sides.
- Executing loops at their boundaries and within their operational bounds.

5.5.1.2 Black Box Testing

Black Box testing is used to evaluate the system by demonstrating the operational functions of the system. It performs this evaluation by testing is inputs are properly accepted and the output is correctly produced.[1] It complements White Box testing and is very likely to uncover classes or errors that was passed by White Box testing. Black Box testing attempts to find errors in the e-learning software by the succeeding categories:

- Incorrect or missing functions
- Interface errors
- External database access errors

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[1] R.S Pressman, *Software Engineeering: A Practitioner's Approach.* 4th ed. New York: McGraw-Hill, Inc., 1992.

- Performance error
- Initialization and termination errors.

5.5.2 Testing Strategies

Testing was conducted throughout the development of the e-learning software. The testing consists of unit testing, integration testing and system testing.

5.5.2.1 Unit Testing

Unit testing focuses on the module, which is the smallest component of the software. Each module is tested individually, or independent of one another, to ensure their correctness. Functions and procedures in each module are examined carefully for errors after coding. Once the modules have been tested and found to be error free, they are then compiled and run with test data to search for other errors.

Unit testing involves:

- Testing the interface to ensure proper information flows in and out the program units.
- Testing the boundary conditions to ensure the module operates correctly at these values.
- Ensuring that all independent paths in a module have been executed at least once.

For the e-learning software, unit testing is done concurrently with the development phase. For example, the Test module has a sub-module that updates the database based on the users login ID. Other modules such as the Administrative Console also have sub-modules that perform different roles of updating, deleting and adding data to the database. Each one of this functionality will be reviewed and checked separately. The sub-modules are then also tested to make sure that it functions accurately. Once each section or modules have been tested individual the system will then be tested as a whole. In other works, the system will be reviewed as a complete functioning system.

5.5.2.2 Integration Testing

Integration testing is a systematic technique for constructing the program structure while at the same while conducting tests to uncover errors associated with interfacing. The objective is to take unit-tested sub-modules and build a module structure that has been dictated by design.[1]

The integrated testing used in this e-learning software is the bottom-up approach. Each module at the lowest level in the system hierarchy is tested individually. Using this approach the module that is next in line to be tested is the modules that called the previously tested module. During the process of testing, interfacing errors will be uncovered and fixed along the way. Considering that the system has been built by sections or modules, errors found can be corrected easily as its functions doesn't overlap significantly with the other modules. Therefore, any such changes to one module will not hamper or change the functionality of another module.

5.5.2.3 System Testing

System testing is a series of different tests whose primary purpose is to fully exercise the computer-based system[1]. System testing ensures or verifies that the system solves the problem as defined by the requirements documents. Function testing comes after integrated testing to test or verify the integrated system to perform its function inline with its functionality requirements as specified in the requirements.

Once this segment of the testing is completed and each integrated system is found to function accordingly, a performance test is done to compare the integrated modules with the non-functional system requirements. These requirements include security, accuracy, speed and reliability.

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[1] R.S Pressman, *Software Engineeering: A Practitioner's Approach.* 4th ed. New York: McGraw-Hill, Inc., 1992.

The final step of system testing is the regression test. This test is done to the e-leaning system to identify new errors that may be introduced as current ones are being corrected. A regression test is a test applied to a new version of a system to verify that it still performs the same functions in the same manner as the older version. For example, in the e-learning software, any changes made by the Administrative Console should not hamper or influence the general function of the system calling in the main user software, such as the encyclopedia module or the level-by-level test module.

5.6 Debugging

Debugging is performed as a consequence of successful testing. When testing is done, and a test case is found with errors, the process or attempting to match the symptoms with the causes, which then leads to the correction of the error, is called debugging. The debugging approach employed was cause elimination. This form of debugging, could identify the data related to the error occurrence and is organized and isolated to its potential causes. A list of all possible causes was developed and tests conducted to eliminate each. If initial tests indicate that a particular cause hypothesis shows promise, the data are refined in an attempt to isolate the error.[1]

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[1] R.S Pressman, *Software Engineeering: A Practitioner's Approach.* 4th ed. New York: McGraw-Hill, Inc., 1992.

CHAPTER VI

EVALUATION AND CONCLUSION

6.1 Problems and solutions

During the planning and development of this e-learning software, various problems where encountered. Below is a documentation of the problems faced and the approaches taken.

6.1.1 Problems and solutions during system studies and analysis

6.1.1.1 Determining the project scope

Due to the fact that the time frame given was rather limited a comprehensive guide of the Human Body could not be included in this e-learning software. The field of Medicine is

vast and varied, but due to the time frame, a particular body part had to be selected (which is the Human Ear), as an example to how the software would work. Also, the amount of features used on this software had to be reviewed time and time again so as to make sure that it was feasible under the said time frame and also to consider the practicality of its use. For example, the use of animation would be a good feature to have on the software as it would encourage the learning process, but at the same time, it would have taken up more time and effort to incorporate it into the software. And also, the use of animation and other media types such as sounds would reduce the loading speed of the software and therefore make it less accessible to the average student who doesn't always have the facility of broadband when using the Internet.

As far as the bulk of the information is concerned, establishing an Administrative Console has solved this. This makes the software rather dynamic as its information can be expanded or manipulated if so needed.

6.1.1.2 Incorporation of test questions

As stated in the earlier part of the thesis, this particular software is only an innovation of an already existing and functioning idea, which is e-learning. There are many other sites accessible through the Internet that does provide medical information for the general public. The one key aspect that distinguishes it from the rest of these software or web site is the level-by-level test, which is where the problem lay at the onset of the thesis.

Upon analyzing the educational route taken by medical students locally or abroad, it was discovered that test are usual in the format of written exams, such as essays and structural questions. Finding the right kind of questions to put into an objective form was difficult and took a lot of interviews with students and doctors and medical professors alike. Though forming structural tests in the software would be a good idea, it would then necessitate that someone such as a professor be available to mark and evaluate the answer given by the user. Though this might be possible if used specifically for class use it would then pile on the work for the medical professors and that didn't seem very practical. Besides that, considering the fact that this software was meant to be readily available to the average user by means of the Internet, objective forms of questions was a

better choice as it didn't need any standby expert in the field to evaluate the answers as it will automatically be done by the software. Furthermore, the results of the test could be displayed to the user almost immediately, giving the user a quick evaluation of their comprehension in the related medical knowledge.

6.1.2 Problems and solutions during the system implementation and testing

6.1.2.1 Lack of experience in Web-based programming

As there was minimal exposure to a web-based environment, a lot of effort was needed to become familiar with the available software and the concepts of web programming. Web programming is indeed very distinct from the conventional programming manner. With the availability of different web development tools in the market it took a lot of hard work to learn up these different software and also at the same time learn up programming languages that would be useful in building this software. Using the Dreamweaver Ultradev web development tool was a wise choice as it automatically generated most of the codes needed, and also the use of ASP was also a good decision as it has a short learning curve and was easier to comprehend. Looking through the Internet, talking and discussing with experts in the field such as programmers and also lots of self-study helped solved the said problem.

6.2 System Strengths

The e-learning software that has been developed has some features that distinguish it from the other e-learning packages in the market. Below is a documentation of some of the system strengths.

6.2.1 User-friendly Interface

The e-learning software that was developed has a very user-friendly interface that easily understood even by a user with the minimal understanding in computers. In saying so, users who have used the Internet, will not find the software difficult to use at all. Incorporated in this software are the effective use of buttons, icons, and hyperlinks that eliminates the need for typing when it comes to capturing the information from the user. This page has good planning making it easy for the user to navigate through the software.

6.2.2 Password protected site

This software has been password protected, meaning that a valid password and user ID is needed. This will prevent against unauthorized access. Only the user with the correct administrator user ID and password can temper with the information in the software and the database of the software. This also means that the software prohibits unauthorized access by users to the administration section.

6.2.3 Query based record retrieval

Since the database may contain thousands of records as the system evolves, a search engine is provided to allow for specific information searching and information retrieval. This feature works in the similar manner that most Internet based search engines work, therefore making it familiar for those who have used search engines like those found in www.google.com and www.yahoo.com. Instructions will guide the user enter a keyword in the input box and by clicking on the search button, the software will make a comprehensive search of the database and list down the information that has been requested by the user.

6.3 System limitations and future enhancements

Though the system has strengths that make it a powerful learning tool for medical students, it does have some limitations that are listed below. Enhancements on these limitations would make it even better as an e-learning software than it already is.

6.3.1 No printing capabilities

The software does not come with printing capabilities, which does work in favor of copyright protected. However, it would be a good benefit for a medical student to be able to print out notes found on the site to be used as reference when the Internet is not available to them. Though print screen or copying and pasting the information in the software may be a valid alternative, the incorporation of a printing feature in the future may prove to be a good enhancement for the software.

6.3.2 No online help facility

Currently the software does not provide any help facility. Though, the interface of the software is indeed very user-friendly, a user without any knowledge web-based software or have never used the Internet may find it a little help useful. The likelihood of this happening is indeed very minimal, especially in this day and age and therefore and enhancement in this aspect is not really needed. With a proper survey however, it can be determined for sure if such a feature is really called for.

6.3.3 No suggested links given for extra information

Many e-learning software available in the market provides the user with hyperlinks to other useful web sites for extra references. This software has not been equipped with such features. This would be a good addition to the software as it is indeed impossible for the software, at least for now, to capture all available information that might be needed by a medical student. Due to the vast and bulk of medical knowledge available

and everyday advancements in the medical knowledge, it would be a good idea to incorporate such hyperlinks within the software to keep it up to date with the progression in the medical world.

6.4 Conclusions

This project has successfully innovated an already existing and available idea. It has managed to create a software that would prove very useful for in class teaching and also out of class references and evaluation for medical students.

In the planning, analysis and development of this project a lot of important knowledge was gained in relations to web programming and tools available to a web programmer. Besides that, it did provide an invaluable insight into how to plan the development of an idea and the final development of the software. In addition to that, it was also interesting to have a better look at the intricacies of the studies that a medical student would have to partake in becoming a trained professional. It also did provide an edge to think innovatively and make improvements on ideas already available in the market today.

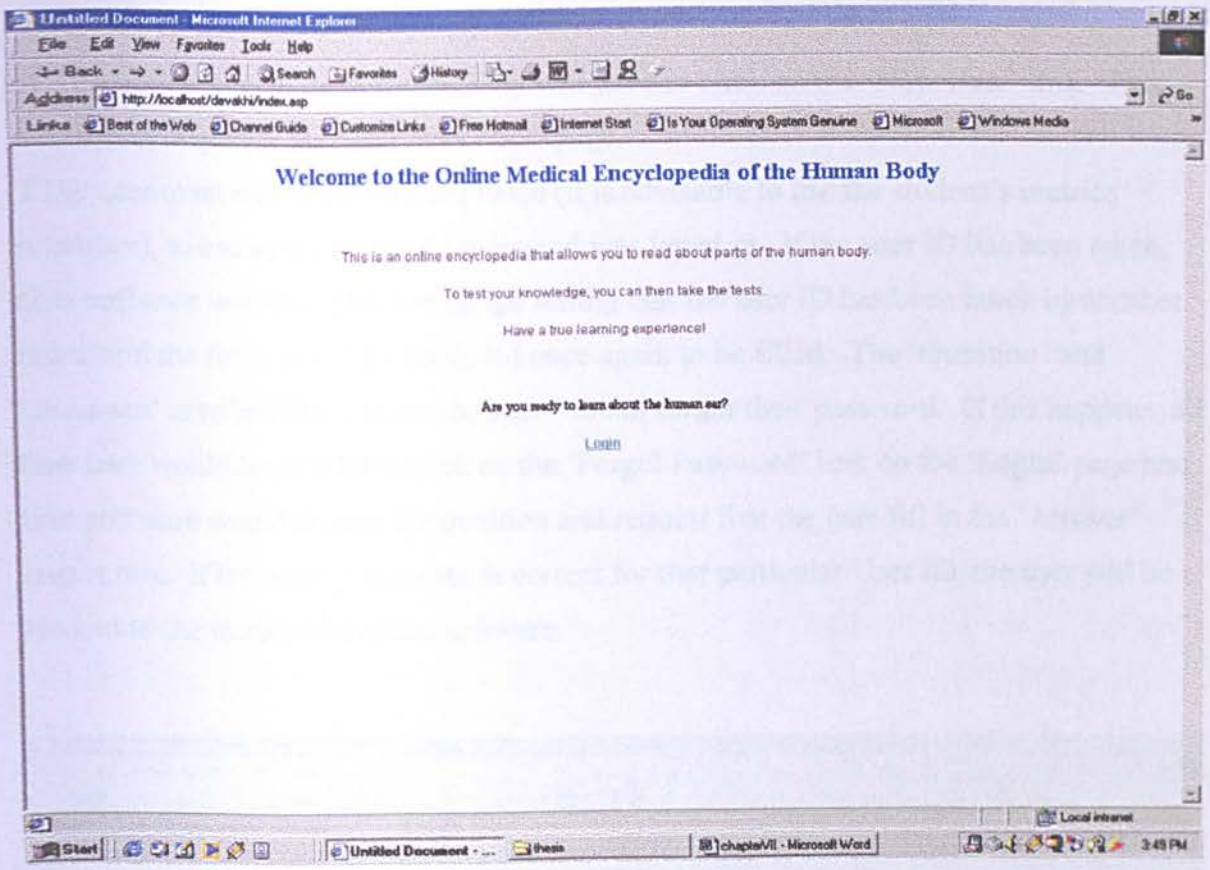
Though some improvements can be made to the software, the development of this software has been able to pave the way to better innovations in the future. It is hoped that the development of this software, would indeed act as a foundation for these future advancements in e-learning softwares in the field of medicine or in other fields.

CHAPTER VII

USER MANUAL

7.1 Log In

The first page that will be displayed is a short introductory page. The user has to click on 'Login' link to move on to the following web page of the software.



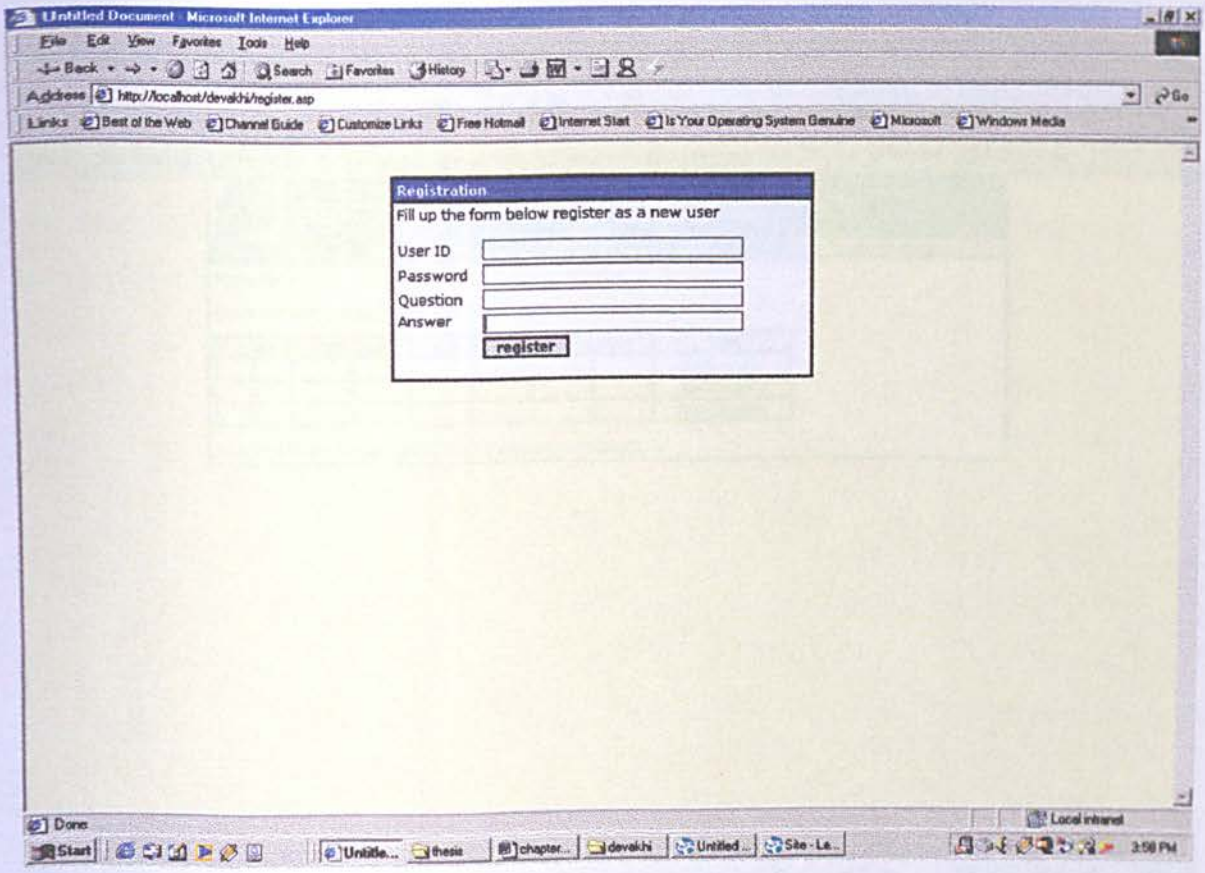
7.1.1 User ID and password verification

The next page that the user will see is the 'User Login' page where the user would have to provide the valid user ID and password to enter the software. Click on the 'Login' button once sure of the user ID and password. If the two data is correct, the user will enter the software main menu. If not, the input boxes will be cleared and the user will still be on the User Login page. In such an occasion, an error message will be provided asking the user to check the password that was entered.

7.1.2 Registering new user

If the user is new to the software, they will have to click on the 'New User' link. This will then display a 'Register New User' page.

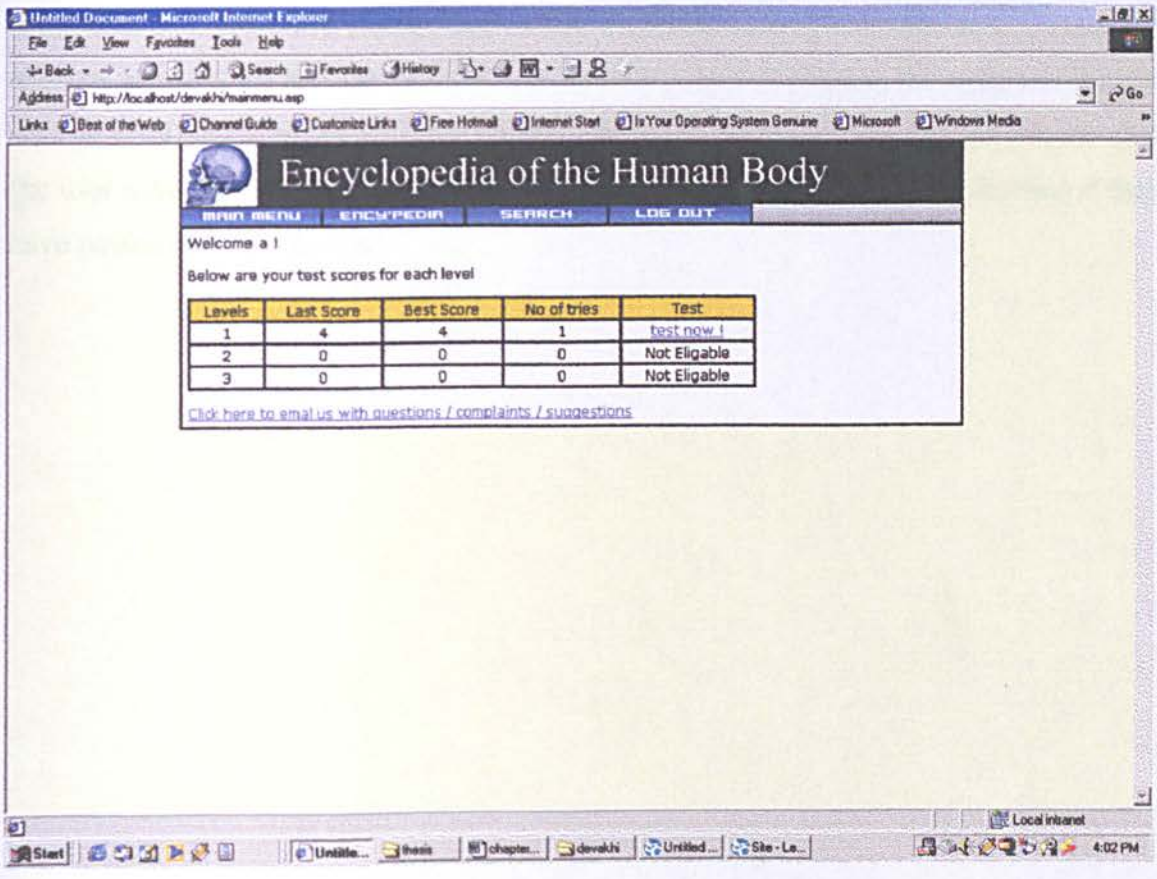
The user must enter the password twice (it is advisable to use the student's metrics number), to ensure that the right password was typed in. If the user ID has been taken, the software would display a message stating that the user ID has been taken by another user and the form would be displayed once again to be filled. The 'Question' and 'Answer' is to be filled in case the user were to forget their password. If this happens, all the user would have to do is click on the 'Forgot Password' link on the 'Login' page and the software would display the question and request that the user fill in the 'Answer' input box. If the answer provided is correct for that particular User ID, the user will be linked to the main menu of the software.



If the registration has been successful, the user will then be linked to the main menu of the software.

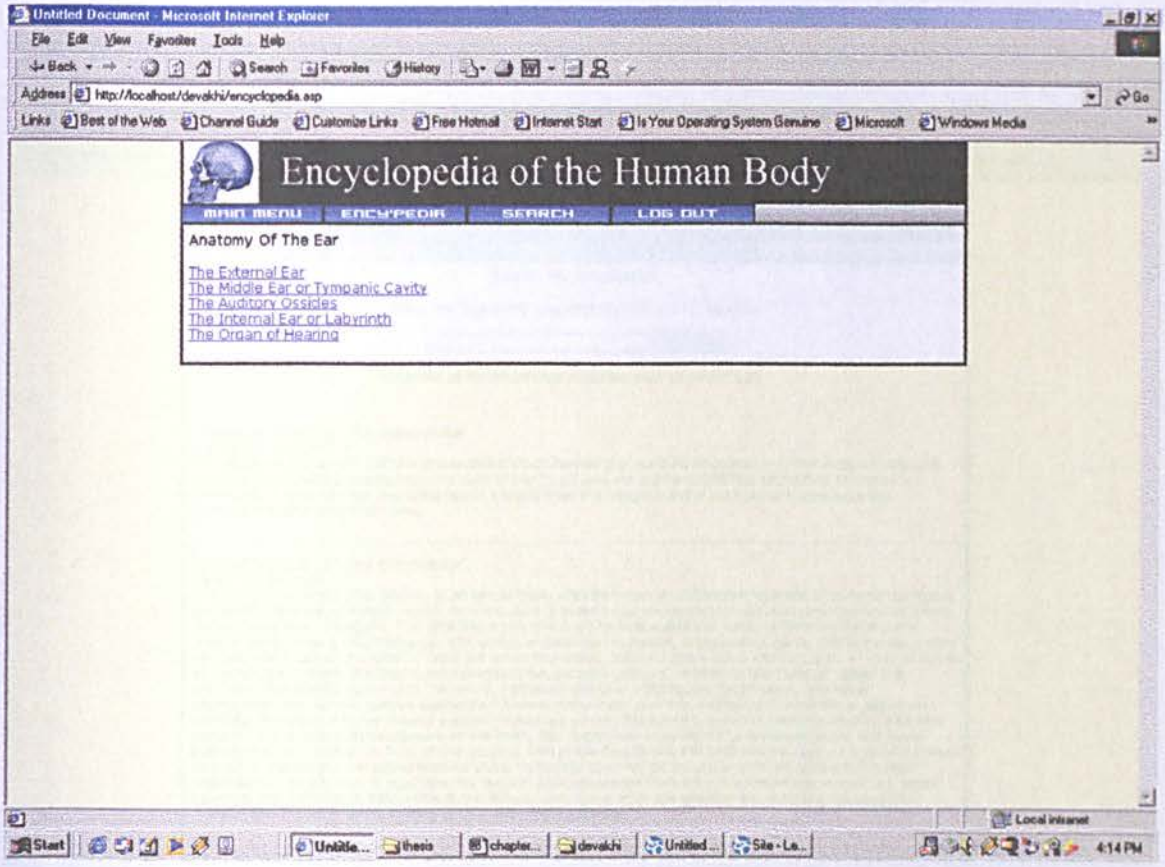
7.2 Main Menu, Encyclopedia, Search Engine and Test

Once the right user ID and password has been provided, the user will enter the software where the user will be provided with the main menu. The main menu would have a welcome message, and a table with the documentation of the user's progress in the tests. There will also be buttons for the user to choose from which are the 'encyclopedia', 'search engine' and 'log out' buttons. The 'log out' button is to exit the software. There will also a hyperlink that, if clicked, would open up an e-mail application where the user could write in their complaints, suggestions or any other message to the administrator of the software. There is also a hyperlink button under the 'Test' column of the table.

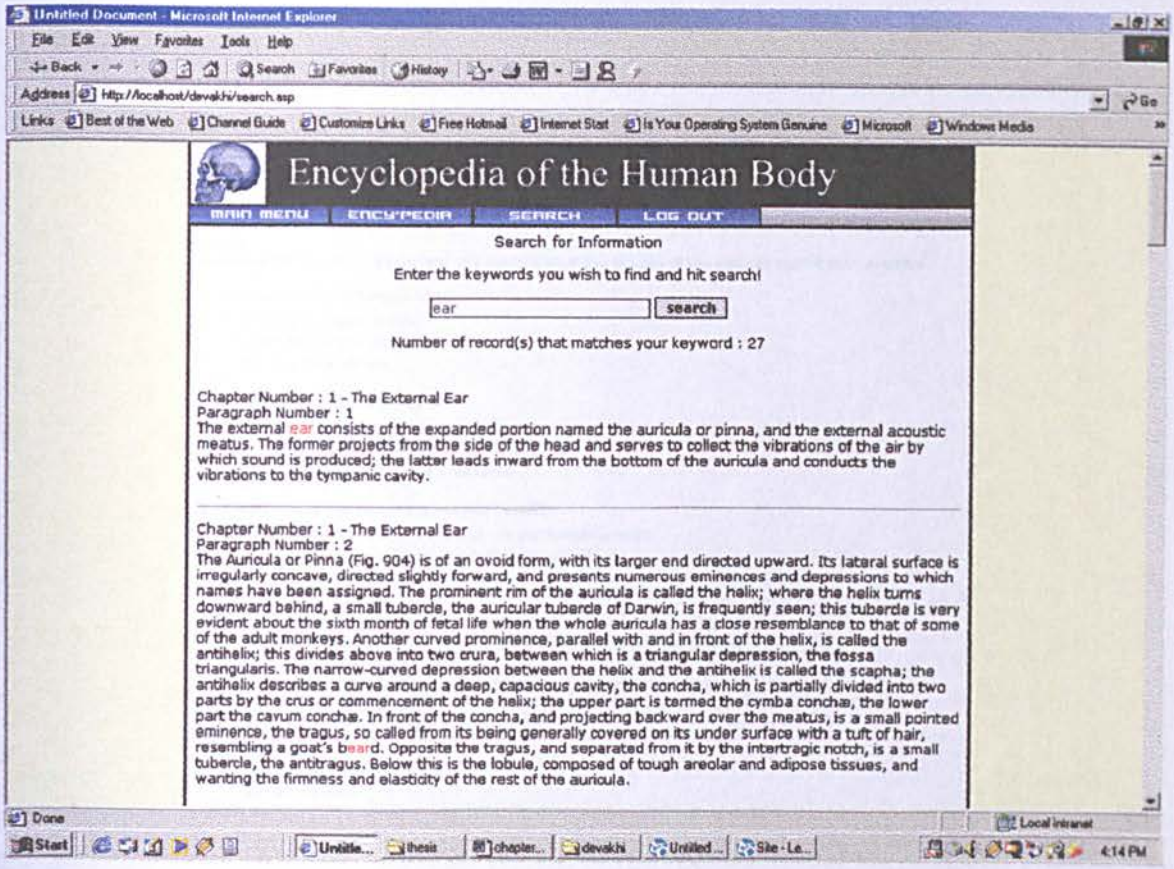


Main Menu

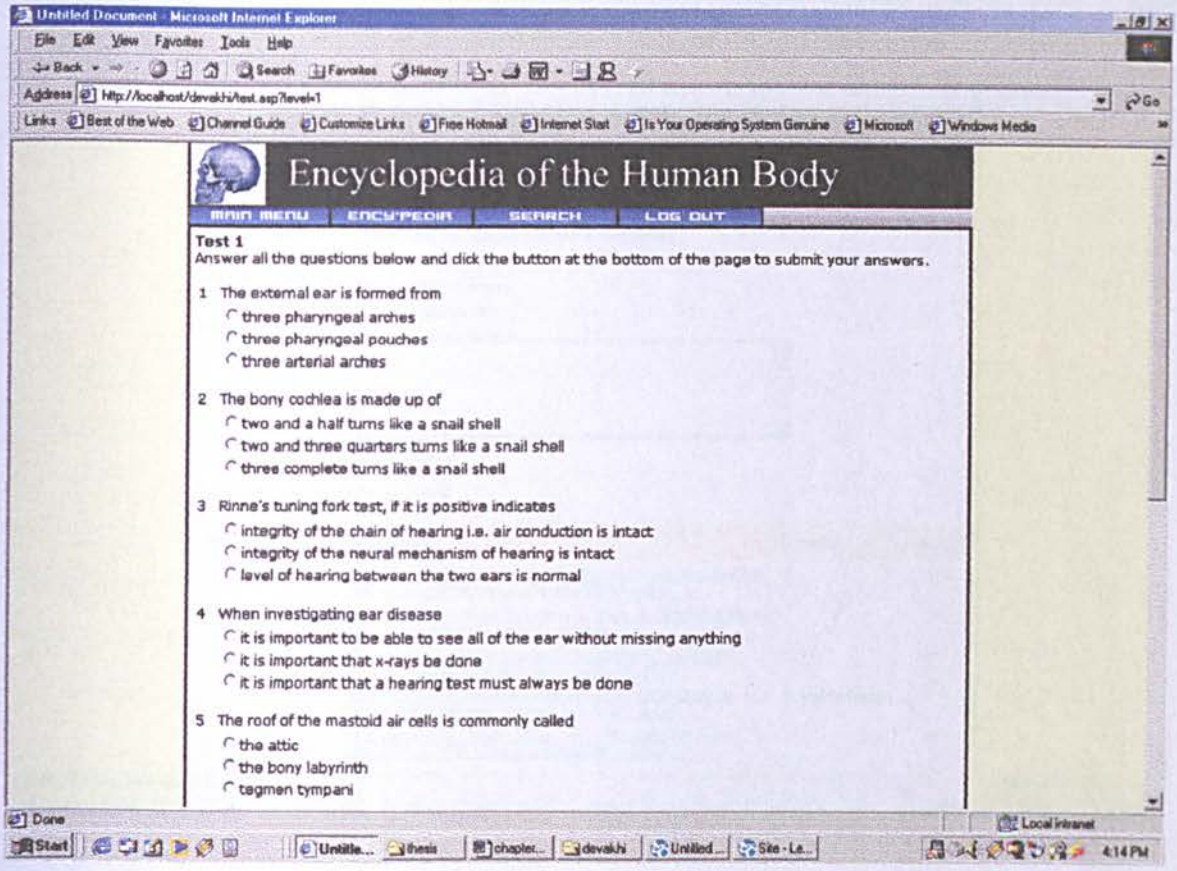
By clicking on the 'Encyclopedia' button, the user will be displayed with the list of titles in the encyclopedia within the software. Each of these titles are in the form of a hyperlink, where if selected by the user, will display the bulk of information regarding that particular title or subject. Clicking on the 'Search Engine' button would provide the user with a search engine, whereby the user would only have to enter some key words of the specific information that they are looking for, and the software would display the records that matches these key words. The keyword will also be highlighted in red throughout the records displayed as a result to the search. And lastly, by clicking on the highlighted link under the 'Test' column of the table in the 'main menu', the user will be displayed with the test page. Here the user will be provided with the related level of test. The user would have to pass the first level of the test in order to access the subsequent levels of the tests; if the user qualifies for the next level of test, the link under the 'Test' column in the table in the 'main menu' will be highlighted. The tests are in an objective form and will randomly change each time the same user sits for the test. Once the answers are selected and the 'Submit Answers Now' button clicked, the results of the test will be displayed together with the correct answer to each question and the answer that the user have chosen for that particular question. The user will also be informed if they have passed or failed the test.



Encyclopedia



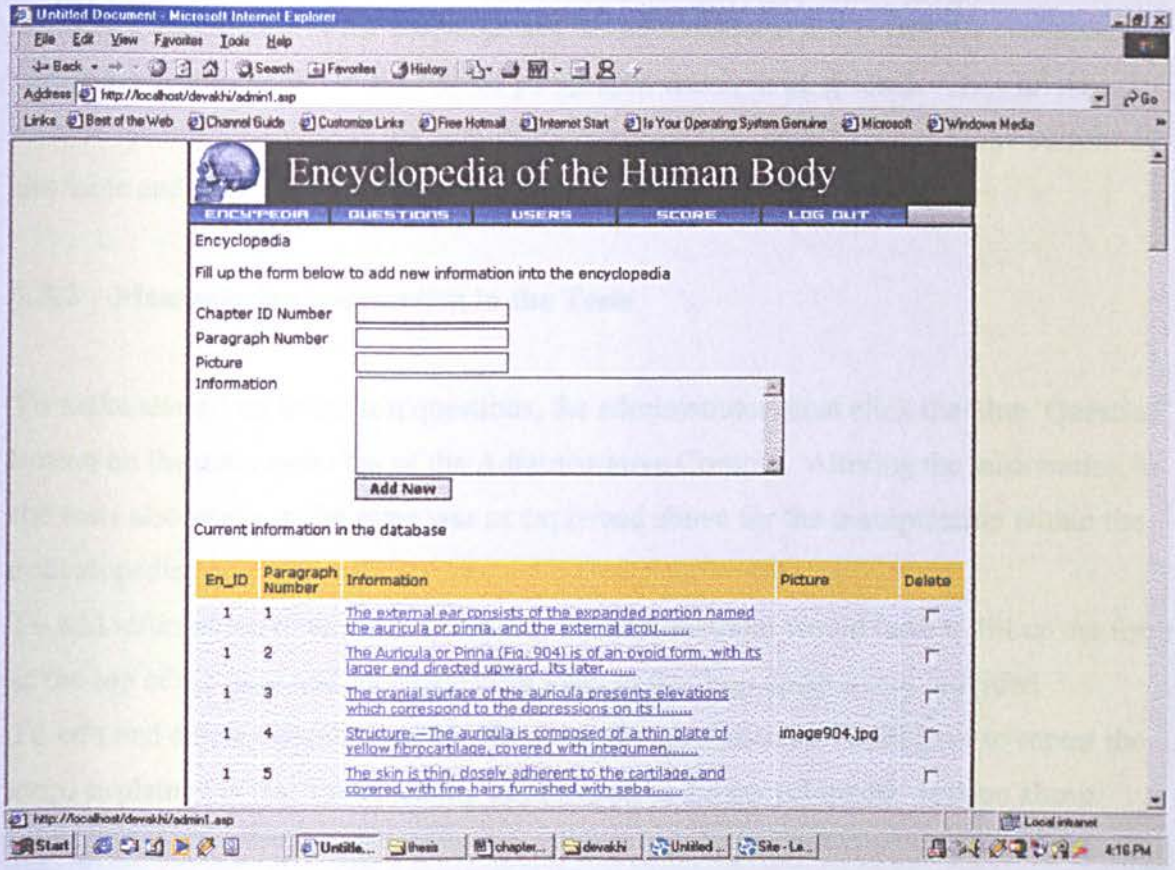
Search Engine



Test

7.3 Administrative Console

The 'Administrative Console' is used by the administrator of the software only. This page can only be accessed by using a specific 'secret' user ID and password in the 'Login' page of the software.



7.3.1 Manipulating information in the Encyclopedia

If the administrator's User ID and password is correct, the administrator will be brought directly into the Administrative Console page displaying the information within the Encyclopedia. To add new information to the encyclopedia, the administrator would then have to fill up the form located at the top of the page which consists the 'Chapter ID Number', 'Paragraph Number', 'Picture' (if any) and the 'Information' (which is the bulk of the Information that is to be added to the encyclopedia).

If the administrator would like to edit the information already available, the administrator need only to click on the related link in the table below, where the bulk of the information will be displayed. Once the administrator has made the desired changes, he or she needs only to click on the 'Submit Edit' button for the changes to be updated into the database of the Encyclopedia.

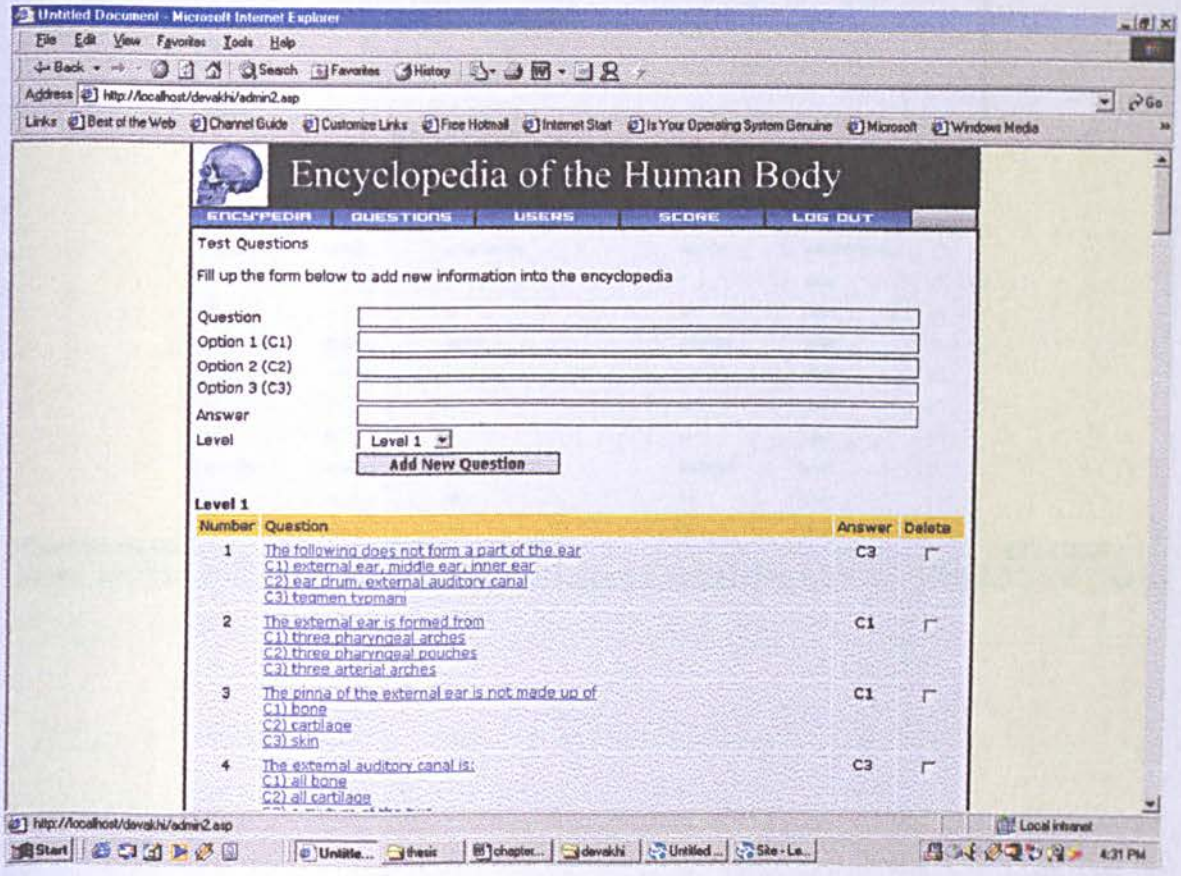
To delete information in the encyclopedia, the administrator must click the checkbox under the delete column of the related paragraphs that is to be deleted. Once all the related records are selected, the administrator would then have to scroll to the bottom of the table and click on the 'Delete' button.

7.3.2 Manipulating information in the Tests

To make alterations to the test questions, the administrator must click the blue 'Question' button on the main menu bar of the Administrative Console. Altering the information in the tests also works in the same was as explained above for the manipulation within the encyclopedia.

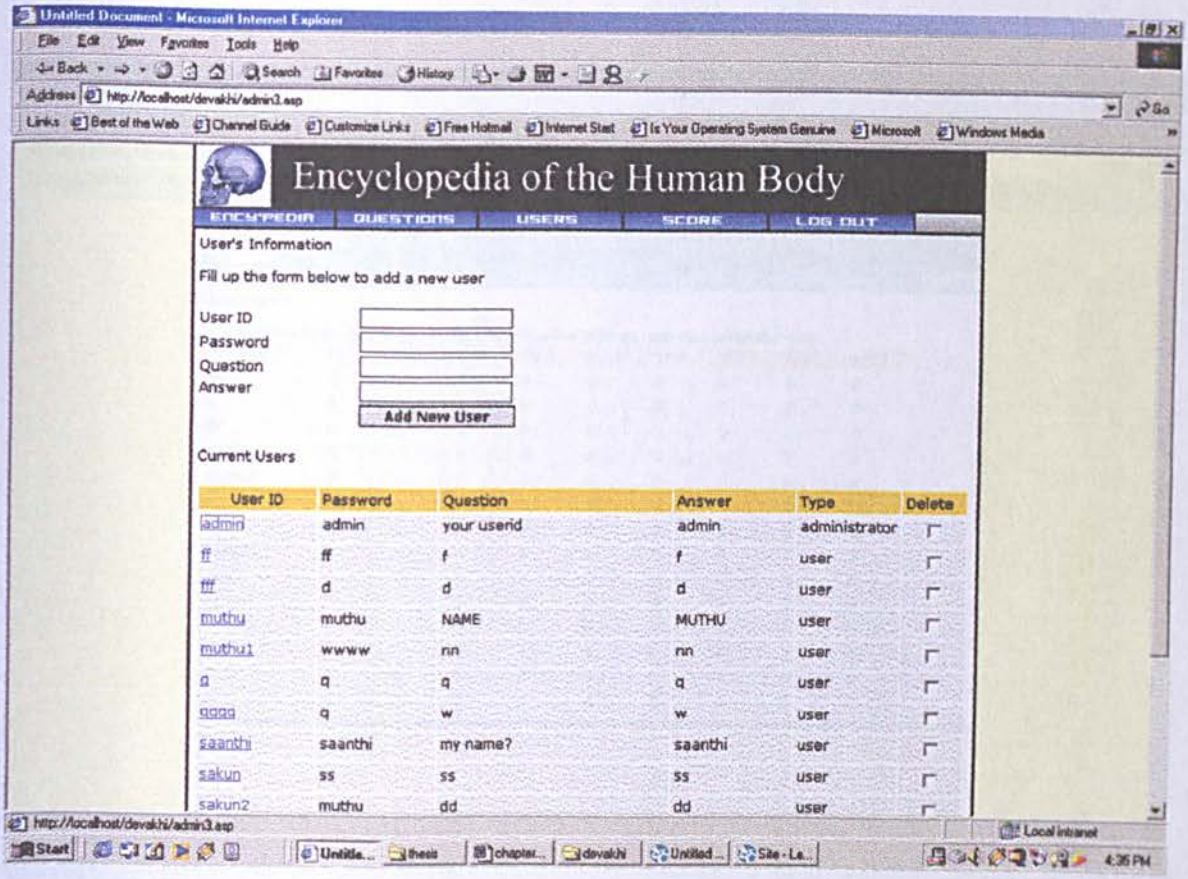
To add information or new test questions, the administrator would have to fill up the form at the top of the page and select the right level in the drop down menu provided.

To edit and delete information from the tests, the administrator could have to repeat the steps explained in the 'manipulating information in the encyclopedia' section above.



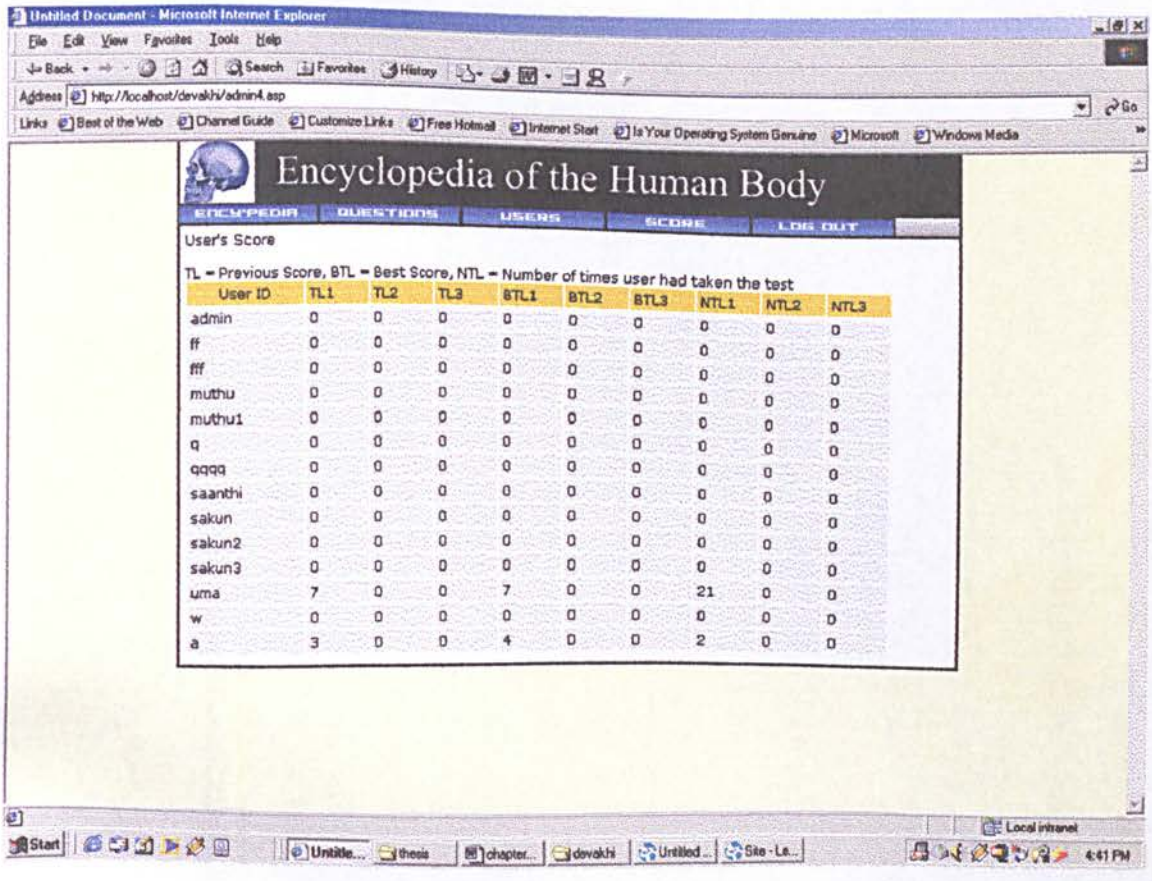
7.3.3 Manipulating the User's information.

By clicking on the blue 'Users' button on the main menu bar of the Administrative Console, the administrator would be provided with the records of the users in the database. Any form of manipulation, such as adding, editing and deleting works in the same manner as the explained previous sections.



7.3.4 Viewing the user's scores

Lastly, the Administrative Console also provides a way to view the entire results of the users scores in the test. To access this table, the administrator need only click the blue 'Score' button on the Administrative Console main menu bar. here, the administrator would be able to view and make a comparison between the previous score of the user, the best score for each level and also the number of tries in each level. This is useful for the administrator to evaluate the kind of progress that each user makes which each try in the different levels of tests.



User ID	TL1	TL2	TL3	BTL1	BTL2	BTL3	NTL1	NTL2	NTL3
admin	0	0	0	0	0	0	0	0	0
ff	0	0	0	0	0	0	0	0	0
fff	0	0	0	0	0	0	0	0	0
muthu	0	0	0	0	0	0	0	0	0
muthu1	0	0	0	0	0	0	0	0	0
q	0	0	0	0	0	0	0	0	0
qqqq	0	0	0	0	0	0	0	0	0
saanthi	0	0	0	0	0	0	0	0	0
sakun	0	0	0	0	0	0	0	0	0
sakun2	0	0	0	0	0	0	0	0	0
sakun3	0	0	0	0	0	0	0	0	0
uma	7	0	0	7	0	0	21	0	0
w	0	0	0	0	0	0	0	0	0
a	3	0	0	4	0	0	2	0	0

Clicking on the blue 'Log Out' button on the Administrator Console page will return the administrator to the software's main introductory page.